CA 2E

Implementation guide

Release 8.7

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Documentation Changes

The following documentation updates have been made since the last release of this documentation:

- Allow RLA access over DDL database
  - The Model Library (see page 25)
  - DDL Collection (see page 27)
- Allow SQL/DDL generation without hard-coded schema name
  - DDL Collection (see page 27)
- DDL Limitation
  - Generate Access Paths (see page 84)

Contents

Chapter 1: CA 2E and Application Development

CA 2E is an application development tool used with the IBM i server. This dynamic tool provides a complete range of interactive facilities to design, generate, document, and maintain applications software.

CA 2E includes CA 2E Toolkit, a set of implementation support and system utilities incorporating menu creation, object management tools, and a full range of automated technical documentation facilities.

This section contains the following topics:

Efficient Design with CA 2E

CA 2E is an application development tool that allows you to design, develop, implement, and maintain application software more efficiently, rigorously, and effectively than current third-generation methods permit. Using CA 2E, you can create programs without having to know a programming language. These programs build applications that manipulate your data according to your business requirements.

An application development tool is more than just a program generator. It helps you determine how your business or organization can be best represented on a computer with respect to the data you need to store and to the functions that operate upon the data.

The data modeling and procedural specification facilities of CA 2E enable you to do precisely this. In other words, your application is stored as business design objects, such as data definitions, interface designs, and action diagrams.

Objectives

CA 2E incorporates a number of industry standard methodologies in application development such as entity-relationship modeling and object-based design. Although CA 2E is a modeling and specification tool, your end product is not just a design; it is a working application system.

CA 2E separates the process of design from implementation. In addition to clarity in development, you benefit in the following ways:

- Changes to the specification can be applied automatically throughout the application design
- Improvements or changes to the implementation can be made independently of the specification
- The same design can be used to implement applications for several different operating systems and environments

Using CA 2E, you receive the following benefits:

- Easy design of applications that are closer to your end user's requirements
- Support in designing better quality applications
- Create applications that are easy to maintain and enhance as your business evolves
- Design applications independently of the language in which you implement them
- Develop systems that make an effective use of the architecture for which they are targeted
- Enable you to design and generate applications multiple times faster than traditional methods

Design Principles

The approach of CA 2E to the design of application systems embodies important design concepts:

- Implementation independence
- Data-driven design
- Object-based design

Each of these concepts is described briefly in the following sections.

Data-Driven Design

The prerequisite of a successful system design is a correctly designed database. If the application data can be defined and described in a careful, organized manner, it is possible to streamline the creation of processing functions that work with the information. To produce an adequate database, you need to rigorously analyze the data you want to store in the system. This can be achieved through relational database design.

Traditional application development has often been a process-driven approach in which the structure of the data is imposed by the processing of each program. Updating the database for business environment changes is difficult since manual checking may be required to ensure consistency.

Within a data-driven design, the business model of your application is held in the data model, enabling database integrity from the outset. Changes to this central design automatically cascade throughout the application design.

For more information on data-driven design, see the section Data Modeling in the chapter "CA 2E Quick Tour" of this guide.

Object-Based Design

One of the key concepts of the i OS operating system is the *object* that actions are performed on. Objects provide:

- A mechanism for modularization. Details of how a process is implemented can be separated from the purpose of the process.
- A way to describe software entities that is easily understood.

At a basic level most languages have a verb-object syntax. Developers tend to think in such terms as Add a Customer or Send an Invoice. CA 2E incorporates this natural language syntax into the design process. The resulting design is expressed in terminology that is easily understood by both the designer and the end users.

The design of CA 2E provides for this object-based approach. This design concept is incorporated in CA 2E where the objects are database entities and the actions are CA 2E functions. These functions specify a system in terms of simple processes operating on entities, independently of how the processes are implemented.

CA 2E focuses on reusable components. Actions and objects are defined once and reused. For example, a subroutine to update a record is defined once. All functions that update records can use this common routine.

Understanding the Application Development Life Cycle

The design principles CA 2E uses are applied throughout the life cycle of application development, including all of the tasks required to start, complete, and maintain an application. CA 2E supports a structured, data-driven approach in the application development life cycle.

To help eliminate errors, CA 2E provides a structured notation that can be interpreted accurately.

CA 2E captures and describes application specifications that reflect users' requirements. After the requirements are represented by the design model and agreed to by the users, the other tasks in the life cycle use this information to ensure the efficient development of the application.

Rapid Prototyping Methodology

Rapid Prototyping Methodology (RPM) is one approach to using CA 2E in the application development process. CA 2E RPM is a data-driven, pragmatic approach to rapid application creation that provides a framework for using CA 2E to build quality systems. The CA 2E RPM life cycle is divided into the following four phases:

- Analyze
- Design
- Construct
- Implement

Analyze

In the analyze phase you can:

- Begin system analysis
- Complete the entity relationship diagram
- Complete the CA 2E data model
- Design primary access paths, function flows, and device designs

Design

In the design phase you can:

- Continue development and prototype application
- Review with the user and update the design
- Continue function definitions, action diagrams, and complete database design

Construct

In the construct phase you can generate the final version of the application and complete unit testing.

Implement

In the implement phase you can:

- Complete integration test, system test, and user acceptance test
- Convert the system

The CA 2E toolset automates many of the traditionally manual, error-prone design and coding processes. The features and capabilities of CA 2E are the driving forces behind CA 2E RPM.

Maintaining Applications

To modify an application you can change your design model as necessary, revisit any function designs that need to take account of the changes, and regenerate all elements dependent on the changes to the files.

For instance, let us say that you want to add a field to a file. CA 2E will automatically add the field to all the necessary access paths (except for those you have earmarked as being unalterable) and make it available on all of the device designs dependent on the access paths. You can use the panel and report design tools to place the field where you want it on these existing designs. The appropriate logic will be added to the function to handle referential integrity checking where appropriate.

You can assess the implications of the changes using interactive inquiries as well as the model documentation reports.

In most cases, regeneration becomes a routine matter. Using the batch generation facilities of CA 2E, it is possible to have an entire system regenerate itself to take account of a database modification.

For example, when a field is used in a function, the function keeps a reference to the field that is resolved when the function is generated. If you make a change, such as to the length of the field, it is reflected within the function's program logic and panel or report design when you next generate the function. This unique feature of CA 2E allows a massive reduction in the maintenance of CA 2E generated applications.

Features

CA 2E allows you to design, develop, implement, and maintain applications software for the IBM i.

CA 2E includes the following features:

- Entity Relationship Specification
  - Automatic creation of a data dictionary
  - Support for free-format text to describe any of the design objects for both designers and end users
  - Automatic documentation of the design model
  - Specification of domain checks
- Access Paths
  - Design of logical views to support functions
  - Retrieval of existing i OS database descriptions
- Functions
  - Automatic creation of action diagram and panel or report design
  - Modular (object-based) design
  - Procedural specification through reusable components and action diagrams
- Panels and Reports
  - Automatic design of panel and report layouts combined with interactive device painting facilities
  - Panel design prototyping facilities
  - Automatic provision of SAA Common User Access design standards
- HLL code generation
  - Generation of Data Description Specification (DDS) source or Structured Query Language (SQL) data definition language for the database
  - Generation of source code for panels and reports
  - Generation of source code (RPG or COBOL) for IBM i stand-alone programs
  - Automatic generation of help text
- Other features include:
  - Automatic implementation of object naming standards
  - Automatic implementation of panel design standards
  - Automated change control of design objects, including change tracking, multi-level impact analysis, model object lists, and function versioning

  - Automated documentation of generated systems
  - Cross reference facilities
  - Integration of user source code within generated functions
  - Regeneration of source code if the model is changed with the preservation of user modifications to the processing specifications
  - Integration of the native facilities of i OS for commitment control, journaling, and error handling
  - Generation of code quickly and easily when the design is changed
  - Automatic generation of referential integrity checks and domain checking
- Documentation features include:
  - Online help text
  - Extensive technical documentation

Change Control Facilities

Change control facilities are a set of features and functions supplied with the CA 2E product for managing design objects. They include:

- Capability of building lists of CA 2E design objects, known as model object lists, for auditing and input to specialized model list commands
- Impact analysis tools, including component change processing
- Model object cross-reference facilities
- Support for versions of functions and messages
- Redirection of functions and messages
- Copying model objects between models
- Centrally recorded model object information

You can use the change control facilities as follows:

- Manage your design objects with specific tools
- Manually control changes to your design model
- Provide an integrated, automated change management solution

Cross-Reference Facilities

CA 2E has a number of facilities to help you identify dependencies between CA 2E model objects. These can be of use when you need to identify the object affected by a particular change.

Change Management

Change Management (CM) automates control of changes to CA 2E design objects and generated applications. CM tracks and controls changes from development to production, enabling impact analysis, concurrent development, and rigorous promotion of objects.

For more information on change management, see the *Change Management User Guide*.

Technical Documentation

You can produce documentation from CA 2E models using the CA 2E documentation commands.

Documenting a Model

You can invoke the commands using the Display Services Menu, or you can call them directly by using the appropriate CA 2E command. You can use the documentation commands on individual objects or groups of objects such as all functions for a file.

Each of the documentation commands has one or more selection parameters with which you can specify the following:

- Selection criteria to identify the CA 2E objects in the model you want to document
- Print options that allow you to specify what information you want listed for the selected design objects

Documenting an Application

The application systems generated by CA 2E follow the CA 2E standards for producing self-documenting systems.

It is possible to run the Toolkit documentation utilities on the generated systems to produce documentation. Objects, members, formats, and fields all have descriptive text specified with the TEXT keyword. Generated source code automatically contains Toolkit source directives to specify a title, compiler overrides, and a synopsis.

With the Toolkit utilities you can create summary and cross-reference documentation directly from HLL source and i OS objects.

National Language Support

National Language Support (NLS) allows you to generate applications in different national languages. NLS is available in two options:

- Generated application
- Advanced

Generated Application Language Support

Generated application language support allows you to generate application modules or components in a number of languages. CA 2E provides national language versions of the default components of your generated application such as help text and function keys.

Advanced National Language Support

Advanced NLS allows CA 2E generated applications to be language independent by removing hard-coded constants from panels and reports and placing them in message files. These message files can then be translated into several languages with the appropriate language resolved at execution. This allows a single set of generated programs and panels to support multiple languages at execution time.

Note: Executing DBCS and ideographic versions requires a DBCS i OS system.

Integrating with Existing Databases and Applications

Descriptions of existing i OS physical files can be retrieved into a CA 2E data model using a process called assimilation. You can add extra relations and define access paths and functions for assimilated files in the same way that you would with other model files.

The three possible approaches to assimilating an existing database include:

- **Assimilation as is**—the existing database is preserved exactly as it is.
- **Assimilation with limited modifications**—the data model implied by the database is preserved, but is normalized or corrected where appropriate.
- **Full assimilation**—the data model implied by the existing database is used as a starting point for a new, normalized model.

Assimilating database files allows you to develop new functions and access paths over an existing database defined outside of CA 2E. It also saves you from having to enter all of the field names and attributes into your model again or having to identify individual fields as you use them on a program-by-program basis.

For more information on assimilation, see the section Data Modeling in the chapter "CA 2E Quick Tour" of this guide.

Getting Help

For online technical assistance and a complete list of locations and phone numbers, contact Customer Support at http://ca.com/supportconnect. Customer support is available 24 hours a day, 7 days a week.

For telephone assistance, call:

U.S. and Canada 1-800-645-3042

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- Portal and business intelligence
- Database management
- Application life cycle management and application development

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For More Information

After reading this *Getting Started* guide, you can refer to the numerous resources for additional information.

Your product DVD contains instructional documents that showcase the software and provide detailed explanations about the product's comprehensive, feature-rich components.

Chapter 2: Components and Installation

This chapter describes the libraries that comprise and the development environment. This chapter also outlines the installation and upgrade process and introduces the Toolkit prototyping facilities.

This section contains the following topics:

Product Libraries

The CA 2E product libraries contain the files and objects needed to use CA 2E. The product libraries include the CA 2E base product library (Y2SY) and Toolkit base product library (Y1SY).

In addition to the base product libraries Y2SY and Y1SY,CA 2E ships additional product libraries that contain the appropriate default national language libraries, the HLL source generators, the CA 2E null model, and a library containing some CA 2E source.

The Y2SYSRC library contains the supplied source for CA 2E. The source for the Toolkit resides in the Y1USRSRC file in the Y1SY library. You can obtain a list of these members with the i OS Work with Members Using PDM (WRKMBRPDM) command.

The Y2SYMDL library contains the CA 2E null model.

Note: At many sites, only Y1SY, Y2SY, Y2SYSRC and Y2SYMDL are listed on the machine. The other libraries are merged into the base product libraries during installation.

The following table provides a complete list of the CA 2E product libraries.

Note: *nll* refers to the national language, for example, Spanish (ESP) or English (ENG).

Ship Name	Library or Folder	Restore Library or Folder
Y1SY	Toolkit base	Y1SY
Y1SYV*nll*	Toolkit LDOs	Y1SY
Y2SY	CA 2E base	Y2SY
Y2SYV*nll*	CA 2E LDOs	Y2SY

Y2SYMDL	CA 2E null model	Y2SYMDL
Y2SYCBL	CA 2E COBOL generators	Y2SYCBL
Y2SYRPG	CA 2E RPG generators	Y2SY
Y2SYSRC	CA 2E source	Y2SYSRC
YLUSLIB0	CA 2E Security Library	YLUSLIB0

Note: The CA 2E Security Library (YLUSLIB0) must be restored to YLUSLIB0. The YCRTLUSLIB command that runs during product installation automatically updates or creates the YLUSLIB library. For more information on this command, see the Product Licensing steps in the *Installation Guide*.

Installing CA 2E

For new users, the *Installation Guide* provides detailed information about the entire installation process. These instructions provide the following information:

- Prerequisites that must be fulfilled before you install
- Step-by-step installation procedures
- Description of required post-load activities necessary to customize the product for your system

Before you begin the installation, be sure to read the instructions in this guide to familiarize yourself with the process.

Upgrading CA 2E

For existing users, new releases may include modifications that must be applied to each design model before you can use new features to work with a model. The Apply Model Change (YAPYMDLCHG) command updates one or all named CA 2E design models with those changes.

For more information about the YAPYMDLCHG command, see the *Command Reference Guide*.

The *Installation Guide* provides detailed information about upgrading to a new version of CA 2E. Before you begin the upgrade, be sure to read the instructions in this guide to familiarize yourself with the process.

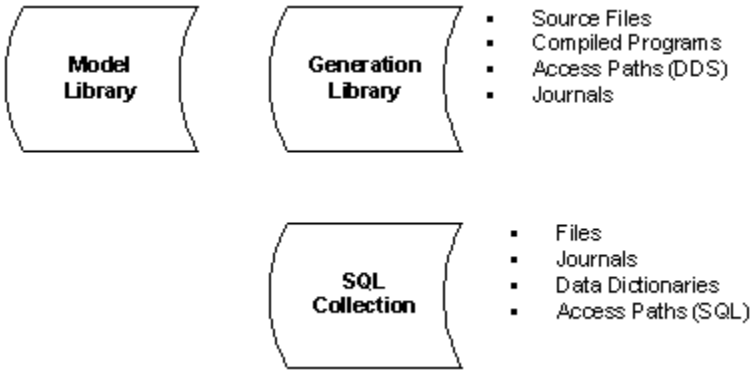
Development Environment

The CA 2E development environment is the model in which the development team creates the application objects and where initial generation takes place. The development environment is also where objects are tested individually to determine whether they function correctly and efficiently.

Development Libraries

Each CA 2E model must reside in a single library called the model library. Each model must also have a generation library associated with it. Models and generation libraries may also be associated with SQL collections. The collection is a separate library similar to the generation library.

The following diagram shows the relationship between the model library, the generation library, and the SQL collection:



The Model Library

Each model library holds the database files that make up the model. The associated generation library contains the source CA 2E generates for the model and the compiled objects from that source. The model library and the generation library should be regarded as a pair. The model library also contains other necessary i OS objects and a CA 2E job description. If the developer generates SQL/DDL, the model library also refers to SQL collections.

The Create Model Library (YCRTMDLLIB) command creates the libraries that compose a model. For more information about the YCRTMDLLIB command, see the *Command Reference Guide*.

Generation Library

The generation library holds CA 2E generated source, compiled objects, and help text. You can move generated objects from the generation library to any other library. You can also move the generation library to an environment that does not contain CA 2E product libraries.

SQL Collection

CA 2E lets you use SQL in place of or along with DDS in data definition statements. Using SQL, you define tables, views, rows, and columns, rather than IBM i server physical files, logical files, records, and fields.

You can implement SQL at both the system level and the model level. If you implement SQL at the system level, all new models default to SQL. When you implement at the model level, all access paths and functions default to SQL. Within a model, you can also specify SQL for individual access paths and functions.

The i OS operating system contains the execution objects necessary to execute applications you generate with SQL. However, if you want to generate and compile CA 2E applications that use SQL, you must have IBM's SQL/400 program products installed and the QSQL library loaded on your IBM i.

To use SQL in a model environment, SQL collections, equivalent to IBM i libraries, must be associated with the model library. The YCRTMDLLIB command can automatically create the SQL collection. This command includes the SQLLIB parameter that lets you create the collection for a particular model.

You can create SQL collections for an existing model with the Create SQL Library (YCRTSQLLIB) command. This command updates the YSQLLIB model value for the associated model. You then use the Change Model Value (YCHGMDLVAL) command to update the YDBFGEN model value to SQL.

See the following references for more information:

- For more information on the YCRTSQLLIB and YCHGMDLVAL commands, see the *Command Reference Guide*.
- For more information on the differences between earlier versions of CA 2E SQL implementations and current implementations, see the SQL Implementation appendix in the *Administrator Guide*.

For more information about IBM's Structured Query Language, see your IBM documentation.

DDL Collection

CA 2E lets you use DDL in place of or along with DDS in data definition statements. You use DDL to define tables, indexes, rows, and columns, rather than IBM i physical files, logical files, records, and fields. There is no view generation when DDL is used as generation method.

You can implement DDL at both the system level and the model level. If you implement DDL at the system level, all new models default to DDL. When you implement at the model level, all access paths and functions default to DDL. Within a model, you can also specify DDL for individual access paths and functions.

The i OS operating system contains the execution objects necessary to execute applications you generate with DDL. However, if you want to generate and compile applications that use DDL, you must have IBM's SQL/400 program products installed and the QSQL library loaded on your IBM i.

To use DDL in a model environment, an SQL collection, equivalent to an IBM i library, must be associated with the model library. The YCRTMDLLIB command can automatically create the SQL collection. This command includes the SQLLIB parameter which lets you create the collection for a particular model.

You can create an SQL collection for an existing model with the Create SQL Library (YCRTSQLLIB) command. This command updates the YSQLLIB model value for the associated model. You then use the Change Model Value (YCHGMDLVAL) command to update the YDBFGEN model value to DDL.

For more information about:

- The YCRTSQLLIB and YCHGMDLVAL commands, see the CA 2E *Command Reference Guide*.
- For differences between earlier versions of CA 2E SQL implementations and current implementations, see the appendix SQL/DDL Implementation in the *Administration Guide*.
- IBM's Structured Query Language, see IBM documentation.

Note: In the earlier releases of CA 2E, it was only possible to create SQL/DDL related tables, views and indexes into SQL Collections. However, the access path generation process has now been modified to enable creation of SQL/DDL tables, views and indexes into normal libraries, in addition to SQL Collections. The SQL/DDL generation has now been modified to do the following

- The YSQLLIB model value can also hold a normal library (non-SQL collection).
- The user is given the option to decide whether to generate the hard coded value present in the YSQLLIB model value into the generated source, through the YSQLCOL model value.

- If the library/SQL collection is not generated into the source during generation (by virtue of YSQLCOL set to *NO), when a compile is submitted to create the SQL/DDL objects, the objects are created into the library/SQL collection specified for the YSQLLIB model value.

Chapter 3: CA 2E Quick Tour

This chapter provides a quick tour of CA 2E and highlights a number of the features while navigating through typical functions. As you proceed through this chapter you will preview many of the steps in sequence that you perform when you develop your applications with CA 2E.

Use this chapter as an introduction to other detailed CA 2E guides such as the:

- *Installation Guide*
- *Tutorial*
- *Administrator Guide*
- *Building Applications*

This section contains the following topics:

Before You Begin

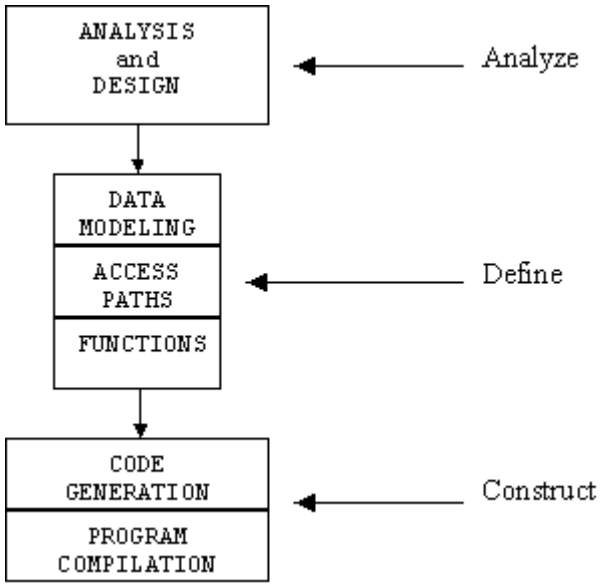
The following conditions must be met before beginning CA 2E development:

- Installation— CA 2E must be installed on your IBM i server.
- Authorization—you must be signed on an IBM i server with a user profile that is authorized to use CA 2E and perform programming operations.
- Library List—your library list must include certain libraries. See the *Installation Guide* for specific details.
- Design Model—a design model must be created. You can use the Create Model Library (YCRTMDLLIB) command as follows:

```
YCRTMDLLIB MDLLIB(MYMDL) OBJPFX(MY)+
 SYSTEXT('My Model') DSNSTD(*CUATEXT)
```

Development Task Quick Tour

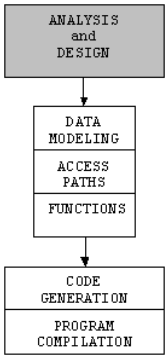
In the development task quick tour of CA 2E, you are introduced to the tasks in the three major phases of development: analyze, define, and construct. The following illustration displays a high level map of the various phases:



Analysis and Design

Analysis and Design is the first major phase of development in CA 2E. Some of the tasks include:

- Making a design model
- Creating prototype panels
- Using Toolkit panel designs
- Entering sample data



The following three components must be established before you begin:

- Business requirements based on business operations
- Data elements based on the identified business requirements
- Entity relationship diagram (ERD)

Most of this information is obtained through discussion and analysis of the business you are working with.

The following lists show examples of the type of results you might obtain for a horse racing business. See the *Tutorial* for further information.

Business requirements may include:

- A record of the Sire (father) and Dam (mother) for each horse to ensure that they are older than the horse
- A record of horses entered in each race
- A list of all horses including a count and total value, and a list of the races each horse has entered

Data elements may include:

- Course name
- Course location
- Course seating capacity
- Horse name
- Horse age
- Horse gender
- Race name
- Race date

These lists are examined and studied to develop an entity relationship diagram. The entity relationship diagram associates data elements with business requirements so the data can be stored in the most logical and efficient manner.

An entity is a significant item with distinct characteristics. The following table contains an example of some possible entities and their relationships to each other:

Entity	Relationships
Course	Has one or more races
Race	Is at one course Has more than one horse

Horse	Is in one or more races

It is often a good idea to draw a picture of the ERD rather than just listing relationships in a table. See the *Tutorial* for more details on relationships.

Entering the Design Model

Start the design model facility in one of the following ways:

- Go directly to the CA 2E Designer (*DSNR) menu using the menu parameter on the Start Y2 (YSTRY2) command from any i OS command entry line as follows:

YSTRY2 LIBLST(MYMDL) MENU(DSNR)

- Bypass the Designer (*DSNR) menu and directly enter your model for editing using the Toolkit Change Library List (YCHGLIBL) command and the Edit Model (YEDTMDL) command from any i OS command entry line as follows:

YCHGLIBL MYMDL
YEDTMDL

The Y2 command is a short form of the YEDTMDL command.

YCHGLIBL MYMDL
Y2

- Enter CA 2E using the Start Y2 (YSTRY2) command, specifying the name of your CA 2E design model as the LIBLST parameter from any i OS command entry line as shown in the following example:

YSTRY2 MYMDL

```
MAIN                          i OS Main Menu

                                System: 2EDV1

Select one of the following:



     1. User tasks

     2. Office tasks

     3. General system tasks

     4. Files, libraries, and folders

     5. Programming

     6. Communications

     7. Define or change the system

     8. Problem handling

     9. Display menu
```

```
    10. Information Assistant options

    11. PC Support tasks



    90. Sign off


Selection or command

===> ystrv2 mymdl_____________________________________________

_____________________________________________________________

F3=Exit    F4=Prompt   F9=Retrieve   F12=Cancel   F13=Information Assistant F23=Set
initial menu
```

Enter **1** in the command entry line as shown in the following example to display the CA 2E Designer (*DSNR) menu:

```
MAIN                          2E Main Menu

Level . :   1

                              System: 2EDV1

Select one of the following:


 Design Model            1. Display Designer (*DSNR) menu

                         2. Display Programmer (*PGMR) menu

                         3. Display User (*USER) menu


                         8. Work with Model Object Lists

                         9. Change to work with another model


 Commands               50. 2E commands in alphabetical order


                        51. Commands to set up or alter a model

                        52. Commands to copy a model
```

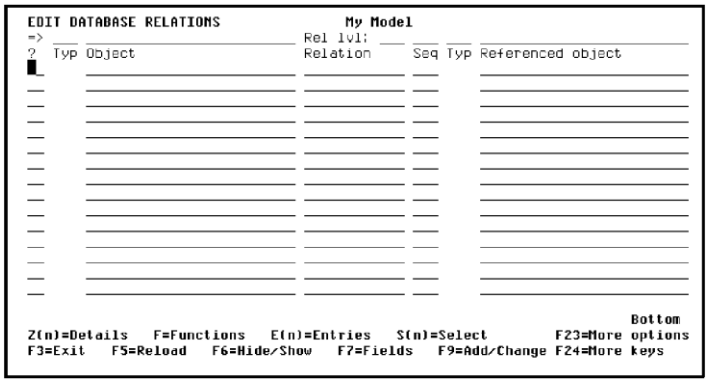
```
                      53. Commands to create an application

                      54. Commands to document a model

                                                              More. . .

Selection or command

===>1_____________________________________________________________

F3=Major Menu  F6=Messages  F8=Rev retrieve F9=Retrieve F10=Cmd Entry F24=More
```

Enter **1** in the command entry line as shown in the following illustration to enter your design model for editing:

```
DSNR                    2E Designer (*DSNR) Menu

Level . :  1

                           System: 2EDV1

Select one of the following:


 Enter Model              1. Edit Database Relations

                          2. Services Menu

                          3. Edit Default Model Object List

                          4. Edit Session List (changed objects)

                          5. Work with Model Objects

                          6. Load model and display command line


                          8. Work with Model Object Lists

                          9. Change to work with another model


 Open Access:           ? 10. Change Open Access Model Value

  Enter with *NO          11. Edit Database Relations

                          12. Services Menu

                                                            More. . .
```

```
Selection or command

===> 1 ____________________________________________________________

F3=Major Menu  F6=Messages  F8=Rev retrieve F9=Retrieve F10=Cmd Entry F24=More
```

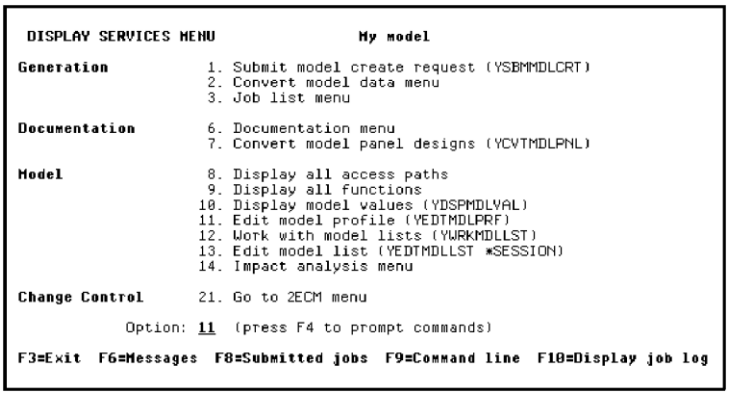
A CA 2E window with the message Starting Advantage 2E Session appears, and then the Edit Database Relations panel displays as shown in the following example:



The Display Services Menu

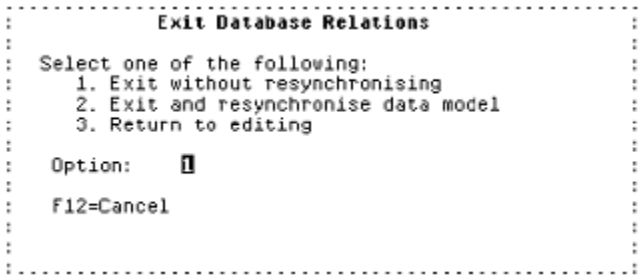
The Display Services menu is an important CA 2E tool that gives you access too many CA 2E support functions while you are working on a model. Access to this menu is available from many CA 2E panels.

If you access the Edit Database Relations panel, press F17 to go to the Display Services menu as shown in the following example:



Leaving the Design Model

To exit your CA 2E design model, press F3 until you reach the Exit menu as shown in the following example:



Prototyping an Application

You can test the feasibility of your design by building a prototype. The Toolkit prototyping facilities let you interactively present a simulated system design. End-users can preview the prototyped system at a workstation.

Toolkit prototyping includes the following benefits:

- Realistic display attributes
- Specification of sample data values for fields
- Function key and value-dependent branching between panels
- Direct attachment of panels to Toolkit or CL menus
- No compilation
- Link with CA 2E that lets you return to CA 2E after prototyping

The prototyping facilities use the following Toolkit commands:

- Display Panel Design (YDSPPNL) displays prototype panel values and sets up sample data.
- Work with Menus (YWRKMNU) creates menus to display prototype panels.

  Note: Specify the YDSPPNL command as the menu action, with the desired Toolkit panel design as the option.
- Go to Menu (YGO) displays menus.

The following references provide additional information:

- For Toolkit commands, see the *Toolkit Reference Guide.*
- For details about Toolkit prototyping, see the Design Aids chapter in the *Toolkit Concepts Guide.*

Creating Prototype Panels

You can create prototype panels in several ways:

- Use the CA 2E Convert Model Panel Designs (YCVTMDLPNL) command.
- Use the CA 2E animate options.

  This method provides a direct link between CA 2E and the Toolkit. It converts CA 2E device designs to the Toolkit, and provides full access to all Toolkit panel editing and simulation functions, and provides the ability to return directly to your CA 2E model.

Each method converts CA 2E function device designs from a CA 2E design model into Toolkit panel designs. Toolkit panel designs reside in a panel design file in a nominated library. The default is your model library. You create panel design files using one of the following components:

- The Toolkit Create Design File (YCRTDSNF) command.
- The CA 2E animate options. If the panel design file does not exist when you convert a model panel, it is created for you.

Naming Prototype Panels

The YCVTMDLPNL command and the animate options create one or more prototype panel designs for each function with a device design. Each prototype panel is given the name of the source member for the program object, as specified in the Edit Function Details panel. For multiple panel designs, each design name includes a numeric suffix. The following provide examples of the naming prototype panels:

- An EDTFIL function with a source member name UUJQEFR results in UUJQEFR1 as the name of the prototype panel
- An EDTRCD function with a source member name UUJQE1R results in UUJQE1R1 for the key panel and UUJQE1R2 for the detail panel

Using Device Design Animation

CA 2E animation provides a direct link between CA 2E and the Toolkit prototyping facilities. You can interactively simulate your CA 2E system design using the Toolkit and easily return to your CA 2E design model.

You animate a CA 2E device design in the following ways:

- Press F2 from the CA 2E device design editor.
- Enter A to animate a selected function from the following CA 2E panels:
  - Open Functions
  - Edit Function Devices

The Animate Function Panels opens. A sample panel is shown next.

```
Animate Function Panels                          My Model

Convert Model Panel. : Y (Y-Yes, N-No)           Convert all panels : Y (Y-Yes,
N-No)
  Replace Navigation : N (Y-Yes, N-No)
  Replace Action Bar : N (Y-Yes, N-No)
  Clear Narrative. . : N (Y-Yes, N-No)
  Clear Test Data. . : N (Y-Yes, N-No)

Panel Name(s). . . . : *SRCMBR *SRCMBR, *SELECT, *panel, name
File . . . . . : YDSNPNL Name
Library. . . . . : *MDLLIB *MDLLIB, *GENLIB, *LIBL, name
Member . . . . . : *FILE *FILE, name

Display. . . . . : Y (Y-Yes, N-No)
  Display Option . . : 1 1-DSPDTA, 2-DSPATR, 3-CHGDTA, 4-WRKPNL

Return to this device design . . . . . : N (Y-Yes, N-No)

Enter=Execute F3=Exit
```

This panel, called the Animate panel, is the bridge between CA 2E and the Toolkit. Use it to specify:

- Whether to convert the CA 2E device design to a Toolkit panel design
- Animation of Common User Access (CUA) panels, action bars, and window definitions
- Whether to keep or replace information associated with the Toolkit panel design, such as, test data and command key and action bar definitions
- The name and location of the Toolkit panel design
- Whether to transfer control to Toolkit
- Where to return within CA 2E

The following sections discuss these actions and alternative ways to achieve them using Toolkit commands.

Converting a Device Design to Toolkit Panel Designs

You can convert a device design into one or more Toolkit panel designs. By default, this process retains the existing Toolkit panel design's command key and action bar navigation, narrative, and data even when you download a new version of the panel design.

You convert a CA 2E device design in either of the following ways:

- Use the CA 2E Convert Model Panel (YCVTMDLPNL) command, which converts multiple CA 2E device designs to Toolkit panel designs in one step in batch.
- Enter **Y** for the Convert Model Panel option on the panel called Animate Function Panels.

  Note: If you enter **N** for the Convert Model Panel option, control is transferred to the Toolkit without converting the CA 2E device design.

Conversion is needed in the following cases:

- A panel design corresponding to your CA 2E device design does not exist in the Toolkit.
- You change the CA 2E device design and need to update the Toolkit panel design to reflect the changes. It is good practice to synchronize the Toolkit panel design with the corresponding CA 2E device design.
- You want to replace the command key or action bar navigation, narrative, or test data you previously defined for the Toolkit panel design.

Converting Multiscreen Functions

By default, if you convert a multiscreen function, such as Edit Record, all panels are converted. The panels are automatically linked together so that you can scroll among them within Toolkit.

If you animate from a CA 2E device design by pressing F2, you can choose to convert only the panel displayed by setting the Convert All Panels option to N.

Replacing Toolkit Navigation and Data

By default, the conversion retains any command key, action bar, narrative, and data entered for the Toolkit panel. The Replace and Clear options let you replace this information. If you are using the Animate Function Panels panel, these options are effective only when the Convert Model Panel option is Y.

Replace Navigation and Replace Action Bar

Use these options to specify whether to keep or replace the command key or action bar navigation you defined for the Toolkit panel design. The default is N, keep the Toolkit navigation.

If you enter **Y**, the navigation you defined in the Toolkit is replaced with the standard CA 2E command key functionality; for example, F3=*EXIT, F12=*PRV. Any function-to-function navigation you defined in the action diagram creates a Toolkit navigation with the value *SAME.

Note: If you have not assigned a function key for exit on your Toolkit panel design and you do not enter **Y** to replace navigation,CA 2E automatically assigns F3 for exit; in other words, F3=*EXIT.

Clear Narrative and Clear Test Data

Use these options to keep or clear any narrative or test data you entered for the Toolkit panel design. The default is N, retain the Toolkit information.

For more information about the YCVTMDLPNL command, see the *Command Reference Guide*.

Transferring Control to the Toolkit

You transfer control to the Toolkit in the following ways:

- Enter **Y** for the Display option on the Animate Function Panels panel.
- If you just want to convert your CA 2E device design to the Toolkit and do not need to display the prototype, enter **N** to return to CA 2E. This is useful to keep your Toolkit panel design and CA 2E device design synchronized.
- Use the Toolkit Work with Panel Design (YWRKPNL) or the Display Panel (YDSPPNL) utilities. You cannot return directly to CA 2E using this method.

Working with a Toolkit Panel Design

You can work with your Toolkit panel design in one of the following ways:

- Enter **4** for the Display Option on the Animate Function Panels panel.
- Use the Toolkit YWRKPNL utility and specify the panel you want to edit. For example, specify *SELECT for the panel name and enter **1** next to the appropriate panel name.

The Toolkit Work with Panel Title Details panel displays as shown in the following example:

```
YDSCTLR
                        Work with Panel Title Details

  Panel. . . . . : UUAJEFR1     Next panel. . . :

  Title. . . . . : Edit Customer

 Print Sequence. :

 Fixed Header. . :   (Y, blank)
 Fixed Footer. . :   (Y, blank)
 Window. . . . . :   (Y, blank)
 Action Bar. . . :   (Y, blank)

 Option. . . . . : 1 1-Panel, 2-Narrative, 3-Command keys,
                     5-Window, 6-Action Bar

 2E related program name . . . . . : UUAJEFR

F3=Exit
```

You can use this panel to perform the following:

- Edit the panel design.
- Enter or edit narrative.
- Define command key and action bar navigation.
- Define a window.

The CA 2E Related Program Name option is the source member name of the CA 2E device design that created this Toolkit panel. It is the link that allows control to be transferred back to CA 2E. This option is blank if the panel was not converted fromCA 2E or was converted before CA 2E, Release 5.0.

Note: More than one Toolkit panel may refer to the same CA 2E source member.

Editing the Panel

To edit your Toolkit panel design, enter **1** from the Work with Panel Title Details panel. Your Toolkit panel design displays in monochrome. If you want to edit your design in color, use the CA 2E device design editor.

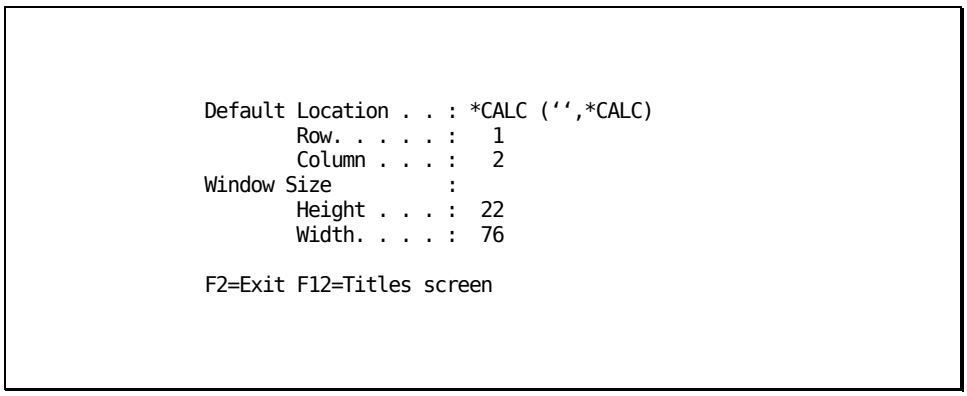
Defining Command Keys

To define command key navigation for your Toolkit panel design, enter **3** from the Work with Panel Title Details panel. The Work with Panel Command Key Usage panel displays.

Note: If you are working with an action bar design, assign *ABAR to the function key that is to activate the action bar.

Building a Window Prototype

The Window option is automatically set to Y on the Work with Panel Title Details panel when you convert a CA 2E window device design as shown in the following example. Press 5 to edit or display the window definition.



You can specify the location of the window in one of the following ways:

- Enter specific values for Row and Column.
- Enter ***CALC** for the Default Location. This causes the upper left corner of the window to display wherever the cursor is located at the time the window is requested. The Row and Column options are ignored.

Define the size of the window by entering values for the Height (in lines) and Width (in characters) options.

Press F12 to continue working with the panel design or press F3 to exit.

Building an Action Bar Prototype

The Action Bar option is automatically set to Y on the Work with Panel Title Details panel when you convert a CA 2E action bar device design.

Enter **6** to edit the action bar definition. The Toolkit Edit Choices panel displays as shown in the following example:

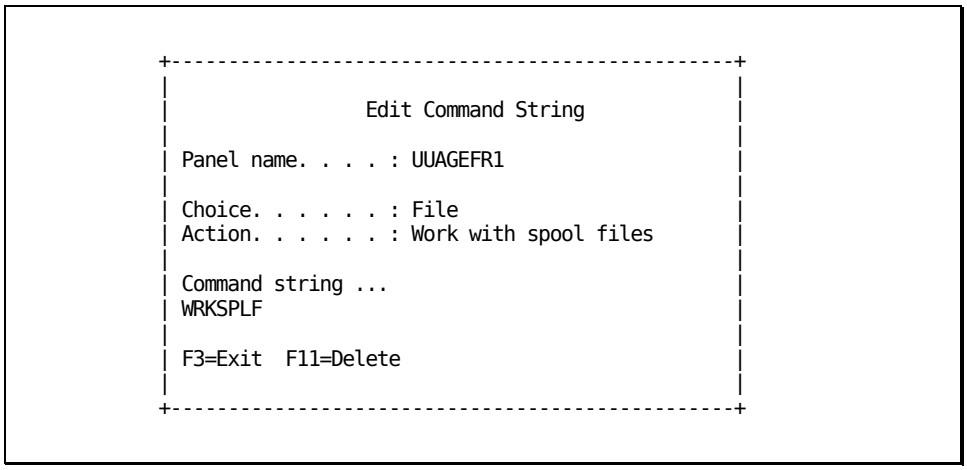
```
YDSCABC  CHANGE                                              MM/DD/YY HH:MM:ss
                            Edit Choices

Panel Name . . . . . :  UUAGEFR1
  File . . . . . :  YDSNPNL
  Library. . . . . :  SYMDL
  Member . . . . . :  YDSNPNL

Choice Sequence .      (position)

Type options, press Enter.
A=Actions  D=Delete

? Sequence Mnemonic Text
    1      E        File
    4      U        Function
   99      H        Help


F3=Exit  F4=Prompt  F9=Go to 'Add' mode  F12=Titles screen
```

The action bar menu choices that currently have actions defined are displayed. Press F9 to add new choices. Enter **A** to edit the actions for an existing menu choice. The Toolkit Edit Actions panel displays as shown in the following example:

```
YDSCABA   CHANGE                                             MM/DD/YY HH:MM:ss
                                Edit Actions

Panel Name. . . . : UUAGEFR1

Choice Sequence . :   3
Choice Text . . . : Work with spool files

Action Number .     (position)

Type options, press Enter.
C=Command String  D=Delete

?  Number  Text                    Next Panel
    2      Open                    *SAME
C   3      Work with spool files   *EXEC
   90      Exit                    *EXIT


F3=Exit  F4=Prompt  F9=Go to 'Add' mode
```

The Next Panel column indicates the result of selecting the corresponding action. For example, Next Panel can contain:

- The name of the CA 2E panel to call when the action is selected.
- *EXIT, which means to exit the panel when the action is selected.
- *EXEC, which lets you execute a command when the action is selected. To edit the command string for *EXEC, enter **C** for the subfile selector; the following window displays:



Note: When defining command key navigation, assign *ABAR to the function key that is to activate the action bar. If you converted a CA 2E action bar device design, the command key assigned to *Actions is automatically assigned *ABAR for the Toolkit command key navigation.

Defining Color

Toolkit panel designs display in full color. Any color assignments you make within CA 2E are automatically converted to the Toolkit. This is the recommended method for assigning color to Toolkit panel designs.

Note: Constants separated by a single space are treated as the same constant, and as a result, constants share the color assignment given to the leftmost constant.

Alternatively, you can assign colors as you edit your panel design within the Toolkit. To do so, position the cursor on the blank before the field to which you want to assign a color and press F16. The following window listing available colors and attributes displays:

```
m Blue          r Highlight
m Green         r Reverse Image
m Pink          r Underline
m Red           r Blink
m Turquoise     r Column Separator
m White         r nondisplay
m Yellow

F3=Exit  F12=Titles screen
```

On some terminals this window will appear as shown in the following example:

```
1. Blue           Highlight
2. Green          Reverse Image
3. Pink           Underline
4. Red            Blink
5. Turquoise      Column Separator
6. White          nondisplay
7. Yellow

F3=Exit  F12=Titles screen
```

Note: The mono display attributes display with an input field instead of a check box to the left of the attribute. You select attributes by entering a **/** in the corresponding input field. The slash is the default selection character; it is contained in the IBM i message, CPX5A0C, in the QCPFMSG file in the QSYS library.

Not all attributes are available for each color. The following table lists the valid combinations supported by DDS, where: CS means Cursor Select, BL means Blink, UL means Underline, HI means Highlight, RI means Reverse Image, and ND means Non-Display.

X1 indicates that the green highlight is white.

Color	CLR	CS	BL	UL	HI	RI	ND
Green	GRN						
						X	
					X1		
					X1	X	
				X			
				X		X	
				X	X1		
							X
White	WHT						
						X	
				X			
Red	RED						
						X	
			X				
			X			X	
				X			
				X		X	
			X	X			
							X
Turquoise	TRQ	X					
		X				X	
		X		X			
		X		X		X	
Yellow	YLW	X					
		X				X	
		X		X			
							X
Pink	PNK						

Color	CLR	CS	BL	UL	HI	RI	ND
						X	
				X			
				X		X	
Blue	BLU						
						X	
				X			
							X

Note: Highlight is only allowed for green, blink is only allowed for red, and column separators are required for turquoise and yellow.

Entering Sample Data

To display your Toolkit panel design to enter sample demonstration data, use one of the following options:

- Enter **3** for the Display Option on the Animate Function Panels panel. You can return to CA 2E by pressing the Home key from any Toolkit panel design.
- Use the Toolkit YDSPPNL command and specify *CHGDTA for the Option parameter.

All fields of your panel design will be available for input and the data you enter is retained on exit.

Displaying Prototype Panels

To display Toolkit panel designs to demonstrate your system design, use one of the following:

- Enter **1** for the Display Option on the Animate Function Panels panel. You can return to CA 2E by pressing the Home key from any Toolkit panel design.
- Use the Toolkit Display Panel Design (YDSPPNL) command and specify ***DSPDTA** for the Option parameter.
- Use the Toolkit YWRKPNL utility and select option 8.

Any sample data you entered previously is displayed. You can enter data in all input fields; however, any data you enter is not retained on exit.

Returning to CA 2E

If you used CA 2E animation to go to the Toolkit, you can return directly to the CA 2E panel or device design from which you started the animation. You return from the Toolkit in one of the following ways:

- If you are editing your Toolkit panel design, press F3 to return to CA 2E. You are provided the opportunity to save any changes you made.
- If you are simulating your application and have defined navigation, press the key you assigned as an exit key, usually F3, to return to CA 2E.
- If you are using the Toolkit to work with your panel design, for example, viewing it, simulating it, or entering data, press the function key assigned for exit (F3 by default) or Home to return to CA 2E.

Note: See the documentation for your terminal or computer to learn which key is the Home key on your system. In addition, the Home key is designed to position the cursor on the first input capable field on the screen. As a result, if the cursor is elsewhere on the screen, you need to press Home twice to return to CA 2E.

The function to which you return depends on the value specified for the Return to this Device Design option on the Animate Function Panels panel when you transferred control to the Toolkit:

- If the value was N, the default, you return to the CA 2E function corresponding to the last Toolkit panel design you accessed. As a result, the corresponding CA 2E function is loaded automatically into Open Functions.

  The function loaded is the function whose implementation name appears in the CA 2E related program name field on the Work with Panel Title Details panel. You can edit the implementation name using this panel. This name automatically defaults when you convert a CA 2E panel.
- If the value was Y, you return to the CA 2E function from which you invoked the animation.

Note: If you invoked the Toolkit using Toolkit commands, you cannot return directly to CA 2E.

Use the following references for more information:

- For information on Toolkit commands, see the Toolkit Reference Guide.
- For information about CA 2E device designs, see the Modifying Device Designs chapter in the Building Applications guide.
- For further details about Toolkit prototyping, see the Design Aids chapter in the Toolkit Concepts Guide.

Defining Data Models

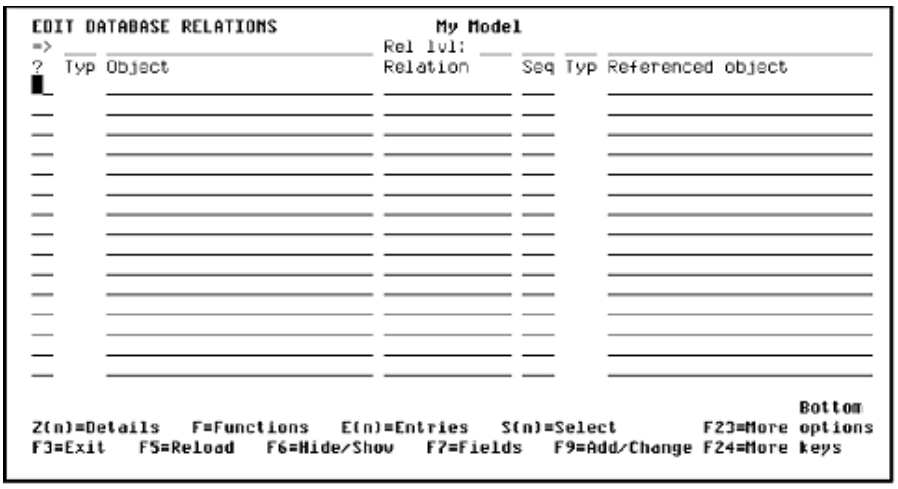
The second major phase of development in CA 2E is the define phase. Data Modeling is the first part of this second phase. It includes the following tasks:

- Defining relations and relationship extensions
- Defining objects
- Defining field details and conditions
- Defining virtual fields

The entity relationship diagram must be translated into a CA 2E data model diagram. This involves entering files and field details, field validation, and default access paths created by CA 2E.

Enter Relations

Use the Edit Database Relations panel to enter relation statements to declare the entities in your data model. The panel shown in the following illustration has three main columns labeled Object, Relation, and Referenced object:



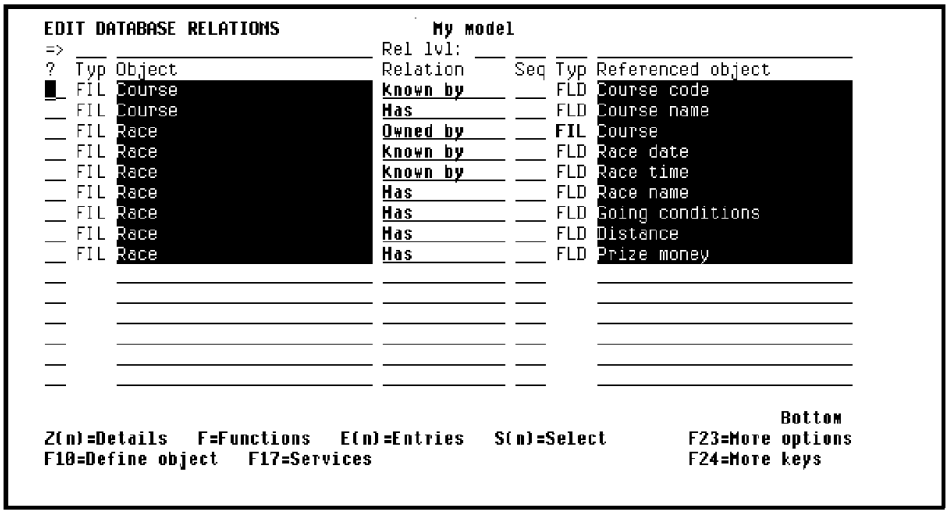
There are eight possible relations; however, the most common relations are:

- Has
- Known by
- Owned by
- Refers to

For ease of use and efficiency, there are some shortcuts for entering relations:

- You can use the DUP key to reduce the amount of typing. When the cursor is in a field and you press the DUP key, values from the previous line will be duplicated on the line below when you press Enter.
- You only need to type the first letter of a relation; for example, you can enter **K** or **O** in place of Known by or Owned by, respectively.

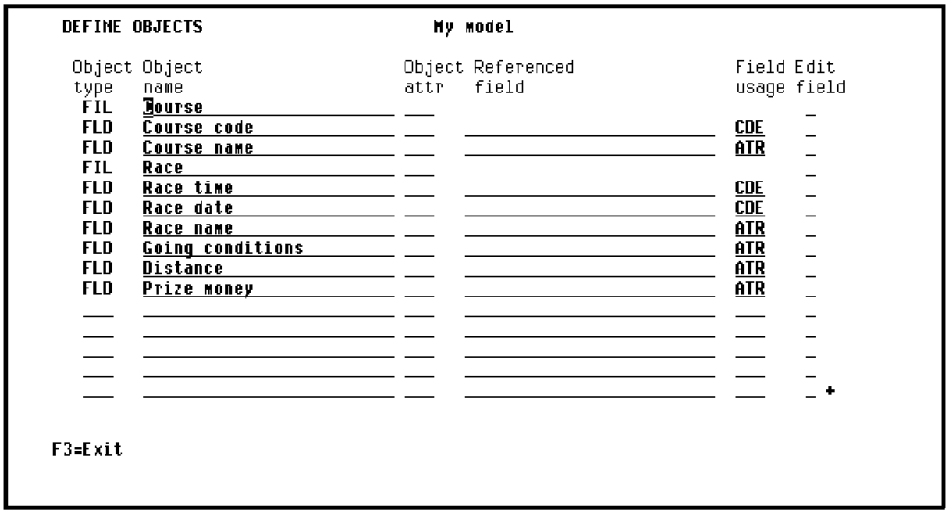
When you press Enter after entering all the relations you will get a display like the following illustration:



Define Objects

The Define Objects panel shows each of the new objects you entered on the Edit Database Relations panel. Based on the relation statements you entered, each new object is automatically assigned a type and each field is assigned a usage, but you must enter the object attributes.

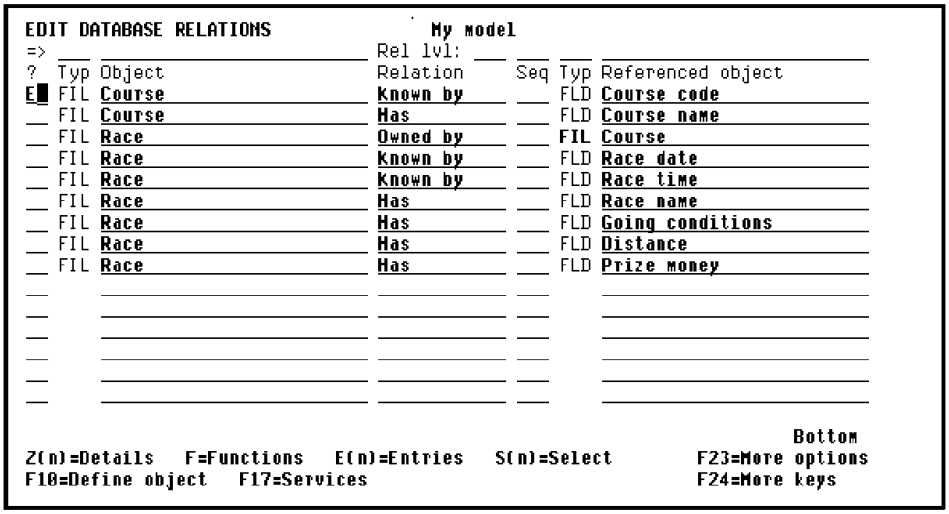
To display the Define Objects panel press F24 to display more function keys, then press F10 to display the Define Objects panel. A sample panel is shown next:



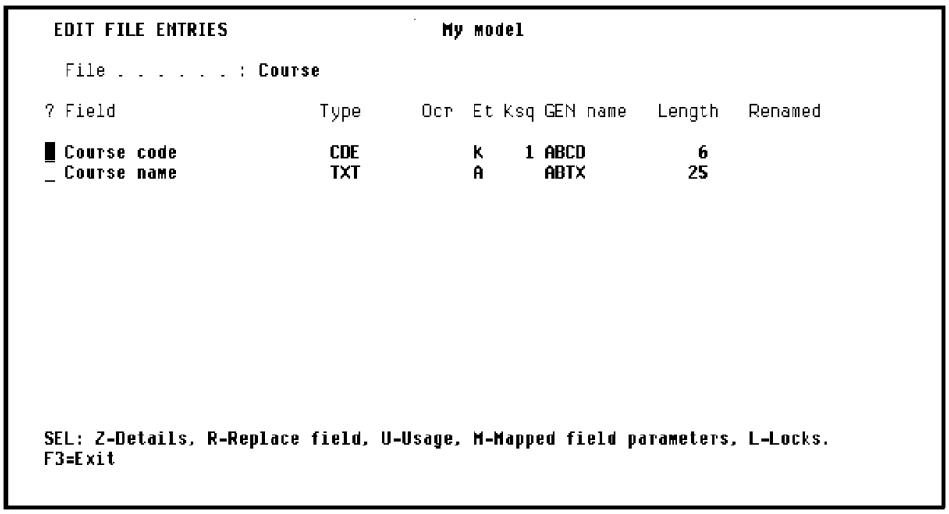
You can view a list of the available object attributes by typing **?** in the object attribute field.

File Entries

CA 2E automatically resolves each relation you entered on the Edit Database Relations panel into one or more file entries. You can view how CA 2E has resolved your relations by displaying the entries for the files. Using the Edit File Entries panel from the Edit Database Relations panel, enter **E** next to any of the relations for the COURSE file. A sample panel is shown next:



Press Enter to display the Edit File Entries panel. This panel shows the file entries that were automatically created for the file:



For each file entry, this panel displays the field names, the field type, whether the field is a key field (K) or an attribute (A), the CA 2E generated implementation name, and the field length. Note that CA 2E assigned the implementation name and default length based on the data type you specified; for example, for fields of type CDE,CA 2E assigns a four-character implementation name ending in CD and a default length of 6.

Documenting Relations

To obtain a listing of the relations that you have entered, use the Document Model Relations (YDOCMDLREL) command. First press F17 from the Edit Database Relations panel to display the Display Services Menu. Then do **one** of the following:

- Press F9 to display a command entry line, enter the YDOCMDLREL command, and press Enter.
- Select the Documentation menu option to display a list of documentation commands and select Document model relations.

Field Details and Conditions

Having entered relations to define your data model, you must now add more detailed information about the fields. This includes defining simple validation rules and specifying any required overrides to the defaults assigned for field properties such as field length.

Field conditions define both the values that a field may take and the meaning that the values represent.

For example, the Horse gender field of the HORSE file will be used to illustrate conditions. Enter **Z2** against the HORSE Has Horse gender relation as shown in the following example:

```
EDIT DATABASE RELATIONS                My model
=> ___ ____________________ Rel lvl: ___ ___ ___ ____________________
?  Typ Object              Relation     Seq Typ Referenced object
__ FIL Course              Known by     ___ FLD Course code
__ FIL Course              Has          ___ FLD Course name
__ FIL Horse               Known by     ___ FLD Horse code
__ FIL Horse               Has          ___ FLD Horse name
Z2 FIL Horse               Has          ___ FLD Horse gender
__ FIL Horse               Has          ___ FLD Horse value
__ FIL Horse               Has          ___ FLD Date of birth
__ FIL Jockey              Known by     ___ FLD Jockey code
__ FIL Jockey              Has          ___ FLD Jockey name
__ FIL Jockey              Has          ___ FLD Jockey gender
__ FIL Race                Owned by     ___ FIL Course
__ FIL Race                Known by     ___ FLD Race date
__ FIL Race                Known by     ___ FLD Race time
__ FIL Race                Has          ___ FLD Race name
__ FIL Race                Has          ___ FLD Going conditions

                                                          More...
Z(n)=Details   F=Functions   E(n)=Entries   S(n)=Select       F23=More options
F10=Define object   F17=Services                           F24=More keys
```

Edit Field Details

Press Enter to display the Edit Field Details panel for Horse gender as shown in the following example:

```
EDIT FIELD DETAILS                      My model

 Field name . .   : Horse gender                Document'n seq. . :

 Type . . . . .   : STS                                   Field usage: ATR

 Internal length. :     1  Data type : A                GEN name: AOST

                           K'bd shift:    Lowercase :

 Headings. . . . . . :-                               Old DDS name:

   Text . . . . . . . . .: Horse gender

   Left hand side text. .: Horse gender

   Right hand side text. : Value

   Column headings. . .  : Horse

                            gender


 Control . . . . . . :-

   Default condition :     *NONE


   Check condition . :     *NONE

   Valid system name. . :      Mandatory fill . .       Translate cnd values:




 F3=Exit, no update     F8=Change name/type      F10=Appearance   F24=More keys
```

To edit the Horse gender field, press F9 from the Edit Field Details panel to display the Edit Field Conditions panel. This panel shows the available conditions for the field. Initially, there are none as shown in the following example:

```
EDIT FIELD CONDITIONS                My model


 Field name. . . . . :  Horse gender            Attr. : STS

 Enter condition . . :                          and type to add new condition.

              type . :      (Type: LST, VAL)


 ? Condition                   Type Op   File/From value   Display/To value    MN
```

```
 SEL: Z-Details, D-Delete, L-Locks, U-Where used, N-Narrative.

 F3=Exit
```

Add Field Conditions

To add a field condition, enter the name and type of the condition. In the following example, one value the Horse gender field can take is Stallion:

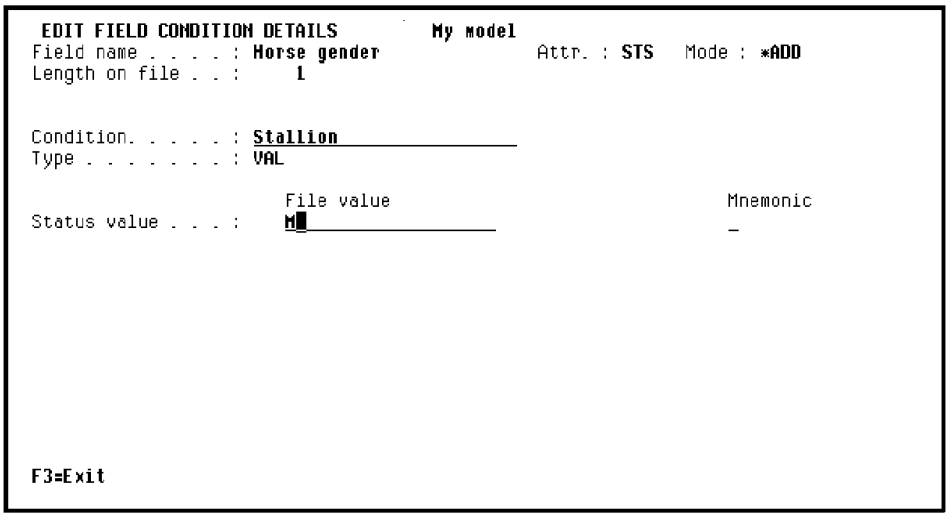
```
 EDIT FIELD CONDITIONS                My model


Field name. . . . . :  Horse gender              Attr. : STS

Enter condition . . :  Stallion                  and type to add new condition.

             type . :  VAL   (Type: LST, VAL)


? Condition              Type Op   File/From value      Display/To value     MN









SEL: Z-Details, D-Delete, L-Locks, U-Where used, N-Narrative.

F3=Exit
```

When you press Enter the Edit Field Condition Details panel appears.

Add Field Condition Detail

The Edit Field Condition Details lets you specify the actual value that is to be stored on the database file to represent a particular condition. For example, you can distinguish between the definition of the condition (Stallion) and the value used to represent the condition on file (M).

The condition value (or Status value) for Stallion is to be represented by an M in the following example:

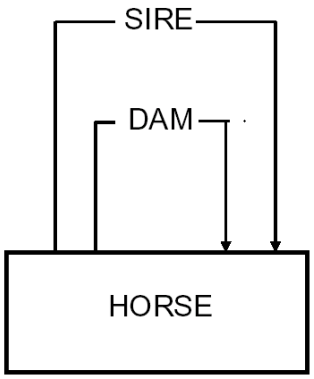


After pressing Enter, the panel is redisplayed, with the message "Condition ‘Stallion’ added" to indicate that the condition has been successfully added.

Relationship Extension

One file can be associated with another by means of the Refers to relation. A file can also reference another file more than once or to itself. To distinguish among multiple references to the same file,CA 2E provides an extended form of the Refers to relation that lets you specify differences among the relations using For text.

In our example a horse's parents are also horses. To record the horse's parents, two HORSE Refers to HORSE relations—one for each parent—must be established as shown in the following illustration:



Because the HORSE file refers to itself more than once, you will need to use the extended form of the Refers to relation to distinguish between the two relations. For further details on how this is accomplished, see the *Tutorial*.

Virtual Fields

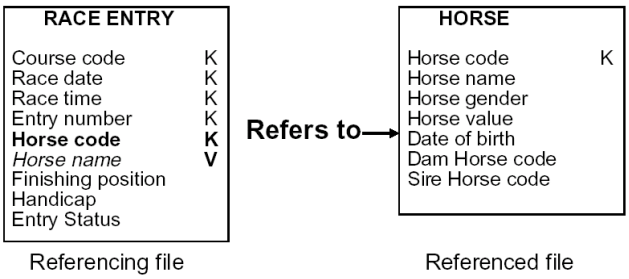
A good database design stores each item of data in only one place, rather than having multiple copies in different files. The i OS join logical file is a mechanism for building views that assemble data from different files.

In CA 2E you use virtual fields to design such views. A *virtual field* is a field that is logically, but not physically, present in a file.CA 2E virtual fields are implemented through i OS join logical files.

When a file is referenced by another file by means of a Refers to relation, entries are automatically created on the referencing file for the key fields of the referenced file. These are known as foreign keys.

To include a non-key field from the referenced file in the referencing file, you need to specify it as a virtual field. This makes the field available for use in the functions that operate upon the referencing file.

For example, to include the name of the horse when displaying the RACE ENTRY file, specify Horse name as a virtual field on the RACE ENTRY file. As a result, Horse name is physically present on the HORSE file, and is logically, but not physically, present on the RACE ENTRY file. This is shown in italics in the following figure:



Note: This same capability is available when two files are associated with each other by means of an Owned by relation. In other words, non-key fields from the owning file may be included in the owned file as virtual fields.

For further details on virtual fields, see the *Tutorial*.

Defining Access Paths

The next stage in defining a design model in the defining stage is to define the required access paths. Access paths specify views of the files in the data model. The views define how data is to be presented to the functions. Functions specify the processes that operate on the data.

Access paths control three different aspects of how data is presented to a function. An access path determines the following:

- Which fields will be available to the function
- Which records will be selected or omitted from the file (select/omit)
- The order in which records are presented (key sequence) to the function

Default Access Paths

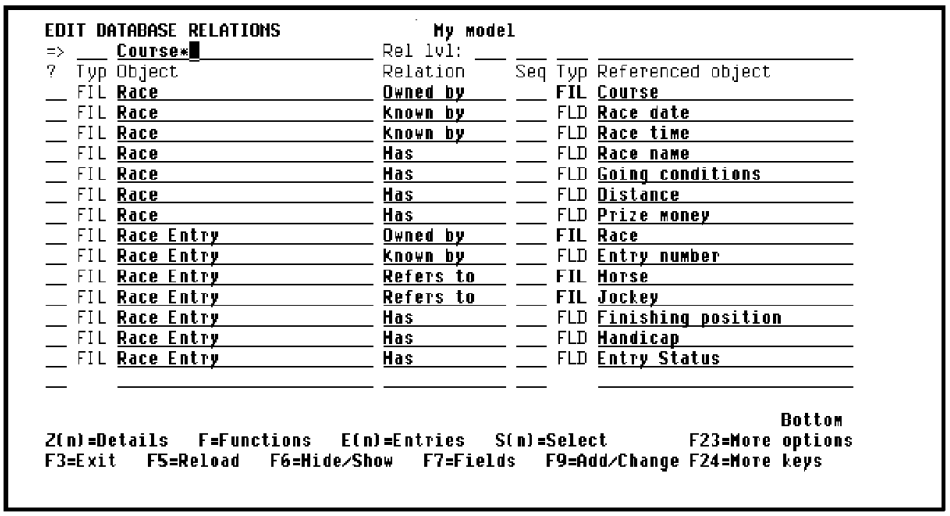
CA 2E uses the relations in the data model to create a default set of access paths for each file. In many cases these will be sufficient. You may override the defaults or define additional access paths.

Three default access paths are automatically created for every file:

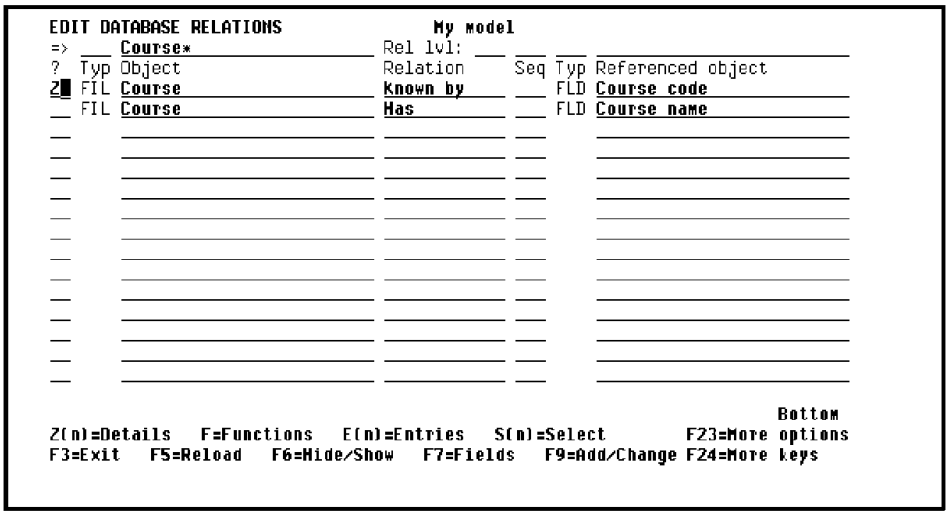
- A physical (PHY) access path (unkeyed). It contains the address of all data stored physically within a file and stored in the order in which the data was written to the file.
- An update (UPD) access path (logical view). It is used to update the file and contains all fields defined for the file. It cannot be altered.
- A retrieval (RTV) access path (logical view). It specifies a view of the data that CA 2E generated programs use to retrieve records from a file. Each file has at least one.

View Default Access Paths

In our example you can enter **Course*** on the selection line to display only relations for the COURSE file. This selection is shown in the following example:



The access paths for a file are recorded on the Edit File Details panel. To obtain this panel for the COURSE file, you will zoom against one of the relations for the file on the Edit Database Relations panel. Enter **Z** against one of the relations for the COURSE file as shown in the following illustration:



Press Enter to display the Edit File Details panel as shown in the following example:

```
EDIT FILE DETAILS                        My model

 File name . . . . . . . . . : Course

 Attribute . . . . . . . . . :  REF              Field reference file.: *NONE

 Documentation sequence. . :                     Source library. . . .: MYGEN

 GEN format prefix . . . . : AB                  Distributed . . . . .: N  (Y,N)

 Assimilated physical. . . :

 Record not found message. :  Course                     NF    Msgid. : USR0001

 Record exists message. . .:  Course                     EX    Msgid. : USR0002


 ? Typ Access path            Source mbr Key    Index options      Auto add
```

```
 PHY Physical file          MYABREP    NONE                        ATR ONLY

   UPD Update index           MYABREL0   UNIQUE IMMED                ATR ONLY

   RTV Retrieval index        MYABREL1   UNIQUE IMMED                ATR ONLY









 SEL: Z-Details, G/J-Generate, E-STRSEU, D-Delete, L-Locks, O-Overrides

      H-Hold/Release, T-Trim, V-Virtualize, U-Usage, F-Func refs., N-Narrative

 F3=Exit F7=Funcs F8=Change name F17=Serv. F18=Triggers  F20=Narr. F22=Locks
```

This panel shows the three default access paths that CA 2E automatically created for the COURSE file.

From this point you can establish access paths with various rules, restrictions and limitations to accomplish desirable results such as:

- You can define an access path to select only certain relations from the file or to include selection criteria based on conditions specified for certain fields.
- You can select or omit records from a view based on data values in specified fields. You can specify none, one, or many select/omit sets for a given access path.
- You can define an access path as either static or dynamic. Static access paths are permanently built into the access paths of the i OS logical files so that the logical files only contain the records that meet the selection criteria. Dynamic access paths are not stored in the access path, but are applied to each record as it is retrieved.

  For implementation details, see the *Tutorial*.

Defining Functions

A function defines a list of processes that will operate on the files and fields in your database.CA 2E provides a variety of standard functions based on your data model to which you can add your own unique processing.

A function can be implemented either as a separate program or as a subroutine within a program. An external function is implemented as a separate HLL program. Each external function is attached to an access path. In general, the standard device functions are external functions. An internal function is implemented as a subroutine of the program that calls it.

You can link functions together to create larger processes that become the building blocks of your applications.

In addition to the standard functions,CA 2E provides message functions, function fields, and built-in functions, that perform low-level processing such as arithmetic operations

This is the third task of the defining phase for development.

Default Reference File Functions

CA 2E automatically creates five default functions for each reference file (REF) you declare: two external functions (Edit File and Select Record), and three internal functions (Change Object, Create Object, and Delete Object).

The two external functions CA 2E automatically creates are:

- Edit File (EDTFIL)—this type of function maintains multiple records on the file.
- Select Record (SELRCD)—this type of function provides a display of the records on the file, and allows the selection of one record for return to a calling program.

Both of these external functions are interactive device functions.

The three internal functions CA 2E automatically creates are:

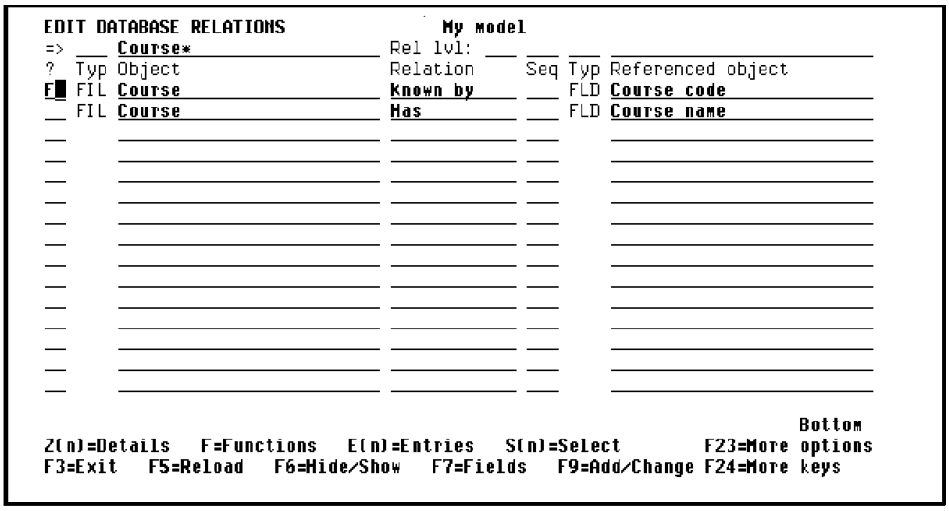
- Change Object (CHGOBJ)
- Create Object (CRTOBJ)
- Delete Object (DLTOBJ)

These functions are used to update the database and are called by external functions as required. They are implemented as subroutines within the generated source code for an external function. Internal functions are specified separately to give you the capability to add additional processing for updating the database. This additional processing is made available to all the functions that call the internal functions.

The five default functions for a file are created the first time you enter **F** against the file on the Edit Database Relations panel. For example, to create the default functions for the COURSE file you would do the following:

First, display just those relations defined for the COURSE file by entering **Course*** on the selection line of the Edit Database Relations panel.

Next, display the functions for a particular file by typing **F** against the file on the Edit Database Relations panel. Enter **F** next to any COURSE file relation as shown in the following example:


EDIT DATABASE RELATIONS
My model
=> ___ Course*
Rel lvl: ___ ___ ___
? Typ Object
Relation
Seq Typ Referenced object
F_ FIL Course
Known by
___ FLD Course code
__ FIL Course
Has
___ FLD Course name
Bottom
Z(n)=Details F=Functions E(n)=Entries S(n)=Select F23=More options
F3=Exit F5=Reload F6=Hide/Show F7=Fields F9=Add/Change F24=More keys

If you press Enter you can view the five default functions for the COURSE file.CA 2E displays messages at the bottom of the panel to indicate this as shown in the following example:

```
EDIT FUNCTIONS                          My model

 File name. . . : Course                                  **   1ST LEVEL  **


 ? Function                  Function type          Access path

   Change Course             Change object          Update index

   Create Course             Create object          Update index

   Delete Course             Delete object          Update index

   Edit Course               Edit file              Retrieval index

   Select Course             Select record          Retrieval index









                                                                        More...

 SEL: Z=Details   P=Parms   F=Action diagram   S=Device   D=Delete   O=Open

      T=Structure   A=Access path   G/J=Generate function   H=Generate HTML ...

 F3=Exit   F5=Reload   F7=File details   F9=Add functions   F23=More options

 F11=Next View   F17=Services   F21=Copy *Template function
```

New Functions

To add a new function you must first create it, and then define additional aspects of the function.

You may choose to add functions for the HORSE file, such as Select Mares and Select Stallion. These functions would enable you to display a list of mares only or stallions only in response to an inquiry.

You would begin by viewing a list of possible function types and access paths for the HORSE file by typing **?** in the Function type column, and typing **?** in the Access path column.

Enter the function names, function types, and access paths as shown in the following illustration:

```
EDIT FUNCTIONS                          My model

 File name. . . : Horse                                  **   1ST LEVEL  **



 ? Function               Function type               Access path

   Change Horse           Change object               Update index

   Create Horse           Create object               Update index

   Delete Horse           Delete object               Update index    Edit Horse
Edit file                   Retrieval index

   Select Horse           Select record               Retrieval index

   Select Mares           Select record               Mares

   Select Stallions       Select record               Stallions









                                                                          More...

 SEL: Z=Details   P=Parms   F=Action diagram   S=Device   D=Delete   O=Open

      T=Structure   A=Access path   G/J=Generate function   H=Generate HTML ...

 F3=Exit   F5=Reload   F7=File details   F9=Add functions   F23=More options
```

```
F11=Next View   F17=Services   F21=Copy *Template function
```

Press Enter and the functions are added.

The two messages "Function ‘Select Mares’ is being created" and "Function ‘Select Stallions’ is being created" will appear briefly at the bottom of the panel. The functions will now be declared to your design model and are available for reference by other functions. At this stage no further definition is required but you will later need to define additional aspects of the new functions before they can be implemented.

Each interactive external function is implemented by:

- An HLL program
- A DDS display file
- A file containing Help text

The implementation language is controlled by the target HLL. You may generate in RPG, COBOL, UNIX, or Client Server Applications depending on your version of CA 2E.

The default implementation language for new functions is controlled by the YHLLGEN model value.

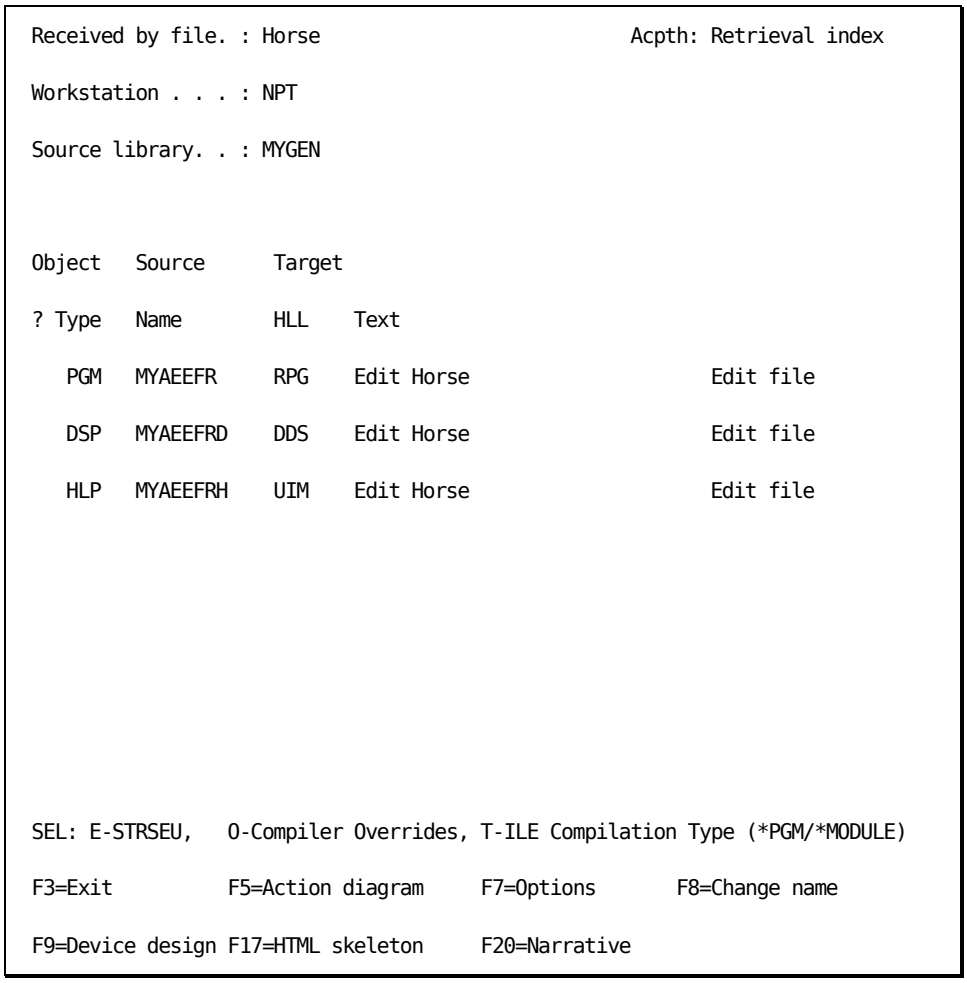
Displaying Functions

To display the details of the Edit Horse function enter **Z** against the Edit Horse function as shown in the following example:

```
EDIT FUNCTIONS                          My model

 File name. . . : Horse                                  **   1ST LEVEL  **


 ? Function                 Function type          Access path

   Change Horse             Change object          Update index

   Create Horse             Create object          Update index

   Delete Horse             Delete object          Update index

Z Edit Horse                Edit file              Retrieval index

   Select Horse             Select record          Retrieval index

   Select Mares             Select record          Mares

   Select Stallions         Select record          Stallions









                                                                    More...

 SEL: Z=Details   P=Parms   F=Action diagram   S=Device   D=Delete   O=Open

      T=Structure   A=Access path   G/J=Generate function   H=Generate HTML ...

 F3=Exit   F5=Reload   F7=File details   F9=Add functions   F23=More options

 F11=Next View   F17=Services   F21=Copy *Template function
```

Press Enter to view function details for the Edit Horse function. Note the program (RPG), display file (DDS), and the help text file (UIM) as shown in the following example:

```
 EDIT FUNCTION DETAILS                      My model


 Function name . . : Edit Horse                    Type : Edit file
```


Received by file. : Horse Acpth: Retrieval index
Workstation . . . : NPT
Source library. . : MYGEN
Object Source Target
? Type Name HLL Text
PGM MYAEEFR RPG Edit Horse Edit file
DSP MYAEEFRD DDS Edit Horse Edit file
HLP MYAEEFRH UIM Edit Horse Edit file
SEL: E-STRSEU, O-Compiler Overrides, T-ILE Compilation Type (*PGM/*MODULE)
F3=Exit F5=Action diagram F7=Options F8=Change name
F9=Device design F17=HTML skeleton F20=Narrative

Function Options

You can modify certain aspects of the behavior of a function. From the Edit Functions panel, enter **Z** against the Edit Horse function, as shown in the following example:

```
EDIT FUNCTIONS                          My model

 File name. . . : Horse                                  **   1ST LEVEL  **


 ? Function               Function type          Access path

   Change Horse           Change object          Update index

   Create Horse           Create object          Update index

   Delete Horse           Delete object          Update index

Z  Edit Horse             Edit file              Retrieval index

   Select Horse           Select record          Retrieval index

   Select Mares           Select record          Mares

   Select Stallions       Select record          Stallions









                                                                  More...
```

```
 SEL: Z=Details   P=Parms   F=Action diagram   S=Device   D=Delete   O=Open

      T=Structure   A=Access path   G/J=Generate function   H=Generate HTML ...

 F3=Exit   F5=Reload   F7=File details   F9=Add functions   F23=More options

 F11=Next View   F17=Services   F21=Copy *Template function

 Function 'Edit Horse' has been saved.
```

Press Enter to display the Edit Function Details panel as shown in the following example:

```
EDIT FUNCTION DETAILS                          My model


 Function name . . : Edit Horse                  Type : Edit file

 Received by file. : Horse                       Acpth: Retrieval index

 Workstation . . . : NPT

 Source library. . : MYGEN


 Object   Source      Target

 ? Type   Name        HLL    Text

    PGM   MYAEEFR     RPG    Edit Horse                    Edit file

    DSP   MYAEEFRD    DDS    Edit Horse                    Edit file

    HLP   MYAEEFRH    UIM    Edit Horse                    Edit file









 SEL: E-STRSEU, O-Compiler Overrides, T-ILE Compilation Type (*PGM/*MODULE)

 F3=Exit             F5=Action diagram    F7=Options       F8=Change name

 F9=Device design    F17=HTML skeleton    F20=Narrative
```

Press F7 to view the Edit Function Options panel. The actual function options available and their defaults depend on the function type.

In this example the following options can be modified:

- **Create record** —this option specifies whether you can create database records. The default is Y, which means you can add database records. If you change this value to N, the function code will not include logic to add database records.
- **Change record** — this option specifies whether you can change database records. The default is Y, which means you can add database records. If you change this value to N, the function code will not include logic to add database records.

- **Delete record**—this option specifies whether you can delete database records. The default is Y, which means you can delete database records. If you change this value to N, the function code will not include logic to delete database records.
- **Dynamic program mode**—this option specifies whether the program will dynamically change the program mode between Add and Change modes, depending upon whether data exists or not. If Dynamic program mode is set to Yes, then at runtime if there are records to be displayed the program mode will be Change and records will be shown. If no records exist, then program mode will be Add and blank lines for adding records will be shown. If Dynamic program mode is set to No, then at runtime the program mode will be Add and the user will have to use F9=Change to see any existing records.
- **Subfile selection**—this option specifies whether there will be subfile select options available within the program or not. If this value is Yes, then the screen will have a column for subfile selection options and allow for subfile option text. If Subfile selection is set to No, then the column for subfile selection options and the subfile option text will not display on the screen.

  Note: If Delete record is allowed, then Subfile selection must be set to Yes.
- **Confirm prompt**—the Confirm prompt option specifies whether the Edit Horse function prompts for confirmation before updating the database files. The default is Y.

  If the Confirm prompt option is Y, a related option, Initially Yes, specifies whether the default for the confirm prompt will be Y or N.

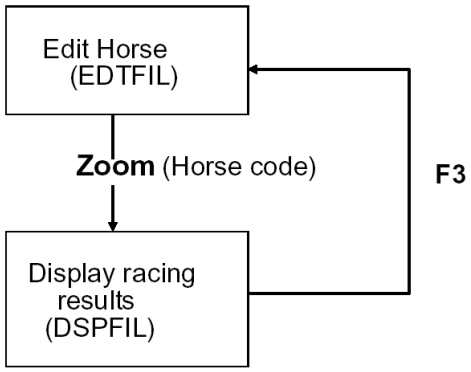
Note: To see full details on other possible function options, see the chapter "Modifying Function Options" in *Building Applications*.

Linking Functions

To link two functions together to build a larger function you must define the second function and an access path on which it is based.

For example, you could modify the Edit Horse function so the user can zoom against the detail line for a particular horse on the Edit Horse panel to view a subsidiary display of the races in which the horse has raced.

The following illustration shows two functions linked together:



To achieve this, you need to define a new function that you might name Display Racing results.CA 2E lets you define the new function while you are in the process of modifying the action diagram of the existing function.

Specifying Function Parameters

This section shows how to specify the parameters that will be passed to the Display Racing results function.

From the Edit Functions panel, enter **P** to edit the parameters as shown in the following example:

```
EDIT FUNCTIONS                                          My model

 File name. . . . :  Race Entry                            **   2ND LEVEL  **


 ? Function                 Function type            Access path

   Change Race Entry        Change object            Update index

   Create Race Entry        Create object            Update index

   Delete Race Entry        Delete object            Update index

P Display Racing results    Display file             Races for a Horse

                                                                        More...

 SEL: Z=Details   P=Parms   F=Action diagram   S=Device   D=Delete   O=Open

      C=Copy   L=Locks   U=Usages   R=References   N=Narrative .. Y=Y2CALL

 F3=Exit   F5=Reload   F7=File details    F9=Add functions   F23=More options

 F11=Next View    F17=Services    F21=Copy *Template function
```

Press Enter to display the Edit Function Parameters panel as shown in the following example:

```
EDIT FUNCTION PARAMETERS                          My model
 Function name. . : Display Racing results          Type : Display file
 Received by file : Race Entry                      Acpth: Races for a horse
                                                      Passed       Pgm   Par
 ?  File/*FIELD          Access path/Field/Array             Seq   Ctx   Ctx
    Race Entry           Races for a horse                   KEY

                                                        |
                                                      Values
                                  FLD: One parameter per field
                                  RCD: One parameter for all fields
                                  KEY: One parameter for key fields only

 SEL: Z-Parameter details   X-Object details   D-Delete parameter   N-Narrative
 F3=Exit     F5=Reload   F22=File locks
```

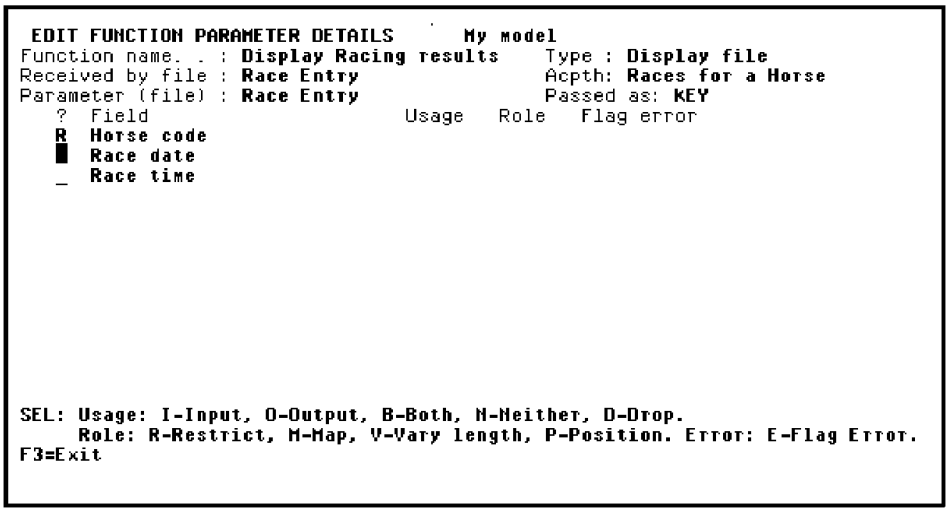
Enter the details as shown in the following example. In other words, enter **Race Entry** as the file name, enter **Races for a Horse** as the access path, enter **KEY** as the Passed as value, and enter **Z** in the Subfile selector to select the key fields on the access path to be used as parameters.

```
 EDIT FUNCTION PARAMETERS                    My model
 Function name. . : Display Racing results      Type : Display file

Received by file : Race Entry                   Acpth: Races for a horse
                                                   Passed          Pgm  Par
  ?  File/*FIELD         Access path/Field/Array          Seq     Ctx  Ctx
  Z  Race Entry          Races for a horse          KEY

                                                     |
                                                   Values
                                FLD: One parameter per field
                                RCD: One parameter for all fields
                                KEY: One parameter for key fields only

 SEL: Z-Parameter details   X-Object details   D-Delete parameter   N-Narrative
 F3=Exit     F5=Reload
```

Press Enter to display the Edit Function Parameter Details panel.

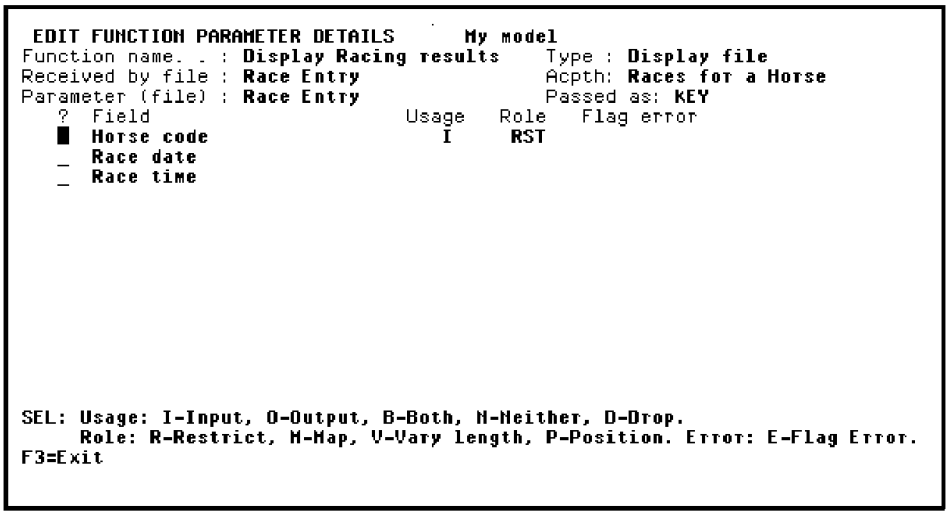
The Horse code from the selected subfile record is to be passed as an input parameter to the Display Racing results function and will be restricted to show only race entries for this horse. This is where you specify that Horse code is an input only, restrictor parameter.

Enter **R** against Horse code as shown in the following example:



Press Enter.

Note that the Usage for Horse code defaulted to I (Input only) and the parameter role changed to RST (restrictor).



Default Panels

CA 2E automatically creates a default interactive panel design for each interactive device function. You can modify the default designs to meet the requirements of your application.

A device design specifies:

- The selection of fields present on a device panel and the accompanying text for each field
- The display of both fields and text may be conditional
- The order in which the fields are displayed on the device panel and how they are edited
- The display attributes for the fields
- The use of each field

These are the defaults from the design model; however, you may override most of them.

You can view the default device design from the Edit Function Details panel by pressing F9 as shown in the following example:

```
EDIT FUNCTION DETAILS                          My model


 Function name . . : Edit Horse                  Type : Edit file

 Received by file. : Horse                       Acpth: Retrieval index

 Workstation . . . : NPT

 Source library. . : MYGEN


 Object    Source      Target

 ? Type    Name        HLL    Text

    PGM    MYAEEFR     RPG    Edit Horse               Edit file

    DSP    MYAEEFRD    DDS    Edit Horse               Edit file

    HLP    MYAEEFRH    UIM    Edit Horse               Edit file
```

```
SEL: E-STRSEU, O-Compiler Overrides, T-ILE Compilation Type (*PGM/*MODULE)

F3=Exit        F5=Action diagram       F7=Options       F8=Change name

F9=Device design    F17=HTML skeleton    F20=Narrative
```

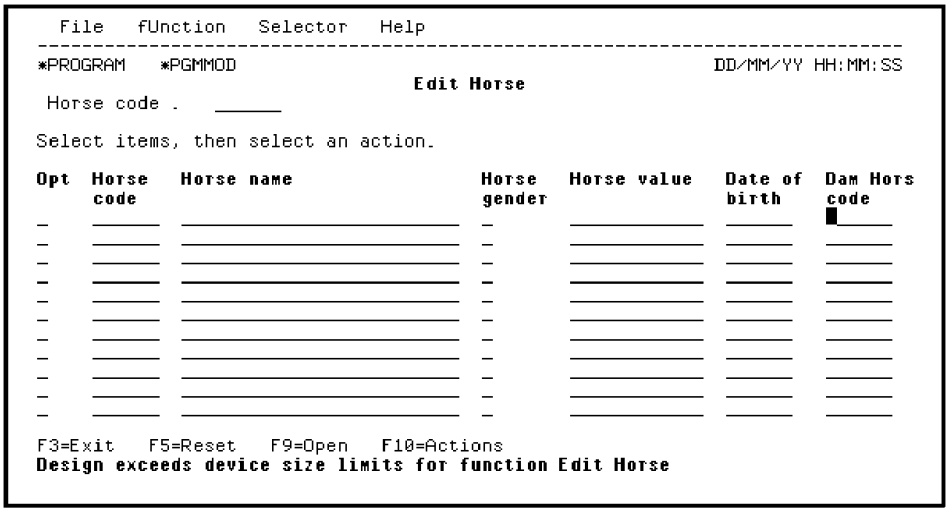
The default panel design for the Edit Horse function displays as shown in the following example:

```
File   fUnction   Selector   Help
--------------------------------------------------------------------------------
*PROGRAM   *PGMMOD                                        DD/MM/YY HH:MM:SS
                                  Edit Horse
 Horse code .   _____

Select items, then select an action.

Opt  Horse   Horse name                  Horse   Horse value   Date of  Dam Hors
     code                                gender                birth    code
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____
_    _____   ____________________________ _       ____________  _____    _____

F3=Exit   F5=Reset   F9=Open   F10=Actions
Design exceeds device size limits for function Edit Horse
```

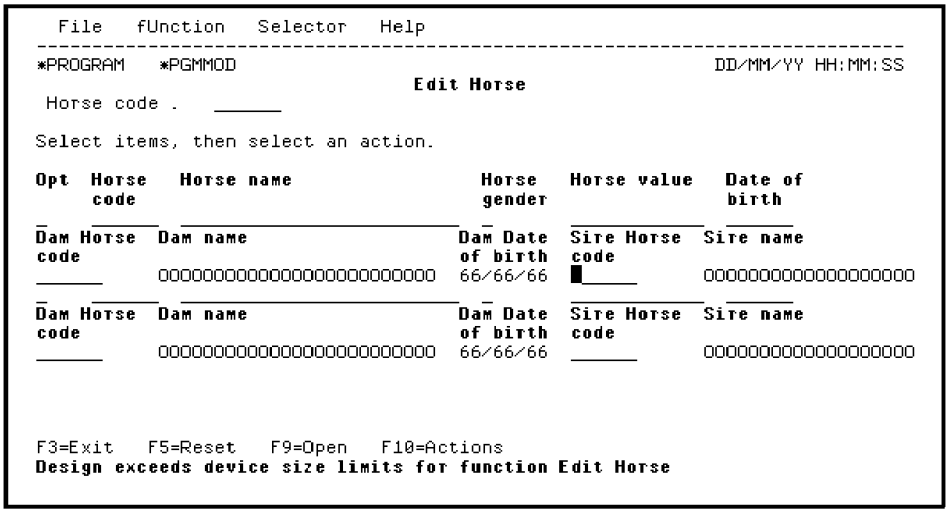
If you want to change the position of a field on the device design, position the cursor on the chosen field and press the F9 function key. For example, to begin the second line with Dam Horse code, you just place the cursor on this field and press F9.

The subfile record format splits into two lines and the device design is updated to reflect the change.

Position the cursor as shown in the following example:



Press F9. The subfile record format now displays only two HORSE records as shown in the following example:



You can repeat the process to move the fields relevant to the Sire to a separate line from those for the Dam by placing the cursor on the Sire Horse code and pressing F9.

For more details on modifying the device design, see the *Tutorial*.

Default Action Diagram

CA 2E supplies a default action diagram for each function. An action diagram contains the processing steps that make up a function. Each action diagram consists of a list of actions, where each action may be either a call to another function or one of a number of low level built-in functions.

To view and edit the default action diagram for the Edit Horse function, from the Edit Function panel enter **F** in the Subfile selector for the Edit Horse function as shown in the following example:

```
EDIT FUNCTIONS                                        My model

 File name. . . . :  Race Entry                            **   1ST LEVEL  **


 ? Function                 Function type            Access path

   Change Race Entry        Change object            Update index

   Create Race Entry        Create object            Update index

   Delete Race Entry        Delete object            Update index

F Display Racing results    Display file             Races for a Horse

                                                                        More...

 SEL: Z=Details   P=Parms   F=Action diagram   S=Device   D=Delete   O=Open

      C=Copy   L=Locks   U=Usages   R=References   N=Narrative ...Y=Y2CALL

 F3=Exit   F5=Reload   F7=File details    F9=Add functions   F23=More options

 F11=Next View    F17=Services    F21=Copy *Template function
```

Press Enter to view the action diagram for the Edit Horse function. An example is shown next:

```
EDIT ACTION DIAGRAM            Edit      My model       Horse

 FIND=>                                                 Edit Horse



 I(C,I,S)F=Insert construct            I(X,O)F=Insert alternate case

 I(A,E,Q,*,+,-,=,=A)F=Insert action    IMF=Insert message

       > Edit Horse

__       .--

__       . ...Initialize                                                <--

__       . .=REPEAT WHILE

__       . |-*ALWAYS

__       . | ...Load first subfile page                                 <--

__       . | PGM.*Reload subfile = CND.*NO

__       . | > Conduct screen conversation

__       . | .=REPEAT WHILE

__       . | |-PGM.*Reload subfile is *NO

__       . | | Display screen

__       . | | ...Process response                                     <--

__       . | '-ENDWHILE
```

```
__       . '-ENDWHILE

__       . ...Closedown                                                 <--

__       '--


 F3=Prev block   F5=User points    F6=Cancel pending moves    F23=More options
```

```
F7=Find          F8=Bookmark          F9=Parameters          F24=More keys
```

The Action Diagram Editor's Subfile selector provides options for editing an action diagram, including options for inserting and manipulating user-defined actions. You can enter **?** in the Subfile selector to view a list of all allowed values.

Code Generation

Generating code is the first part of the third phase of development. You will learn how to generate source to implement the access paths and functions you have created.

You can generate source either interactively or in batch.CA 2E automatically keeps a list of the members to be generated and compiled that have not yet been compiled. We will take a look at how to use batch processing to generate source code and compile executable objects for all of your access paths and functions. These options are available on the Display Services Menu.

For more details on functions, function types, function options, parameter definitions, device designs, and action diagrams, see the *Tutorial* or *Building Applications* guides.

Generate Access Paths

From the Edit Database Relations panel press F17 to go to the Display Services Menu. A sample menu is shown next:

```
EDIT DATABASE RELATIONS                    My model
=> ___ ____________________                Rel lvl: ___ ___ ___ ____________________
?  Typ Object                              Relation     Seq Typ Referenced object
_  FIL Course                              Known by     ___ FLD Course code
__ FIL Course                              Has          ___ FLD Course name
__ FIL Horse                               Known by      10 FLD Horse code
__ FIL Horse                               Has           20 FLD Horse name
__ FIL Horse                               Has           30 FLD Horse gender
__ FIL Horse                               Has           40 FLD Horse value
__ FIL Horse                               Has           50 FLD Date of birth
__ FIL Horse                               Refers to     60 FIL Horse
          For: Dam                                  Sharing: *ALL
__ FIL Horse                               Refers to     70 FIL Horse
          For: Sire                                 Sharing: *ALL
__ FIL Jockey                              Known by     ___ FLD Jockey code
__ FIL Jockey                              Has          ___ FLD Jockey name
__ FIL Jockey                              Has          ___ FLD Jockey gender
__ FIL Race                                Owned by     ___ FIL Course

                                                                          More...
2(n)=Details   F=Functions   E(n)=Entries   S(n)=Select        F23=More options
F3=Exit   F5=Reload   F6=Hide/Show   F7=Fields   F9=Add/Change F24=More keys
```

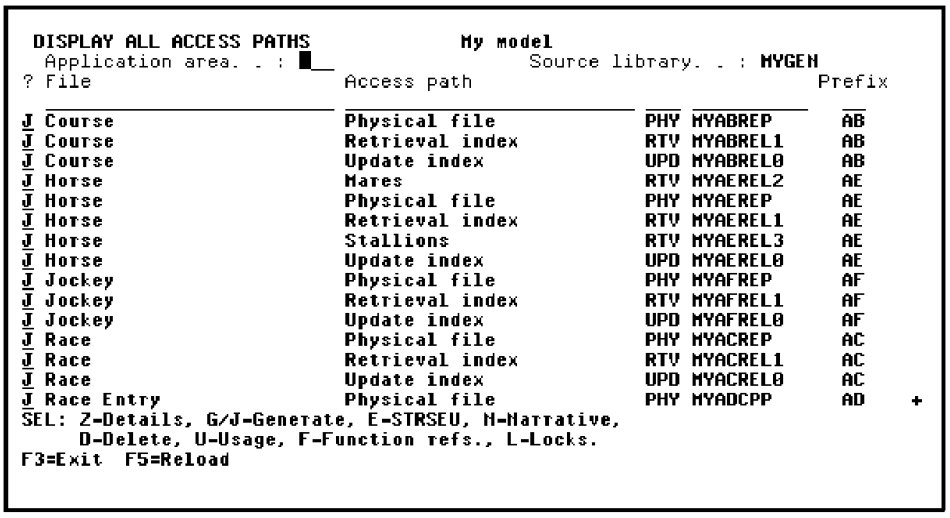
Select the Display all access paths option as shown in the following example:

```
 DISPLAY SERVICES MENU                My model


Generation           1. Submit model create request (YSBMMDLCRT)

                     2. convert model data menu

                     3. Job list menu


Documentation        6. Documentation menu

                     7. Convert model panel designs (YCVTMDLPNL)


Model                8. Display all access paths

                     9. Display all functions

                    10. Display model values (YDSPMDLVAL)

                    11. Edit model profile (YEDTMDLPRF)

                    12. Work with model lists (YWRKMDLLST)

                    13. Edit model list (YEDTMDLLST *SESSION)

                    14. Impact analysis menu


Change Control      21. Go to Management Option (CM) menu


            Option: 8  (press F4 to prompt commands)


F3=Exit    F6=Messages   F8=Submitted jobs  F9=Command line  F10=Display job log
```

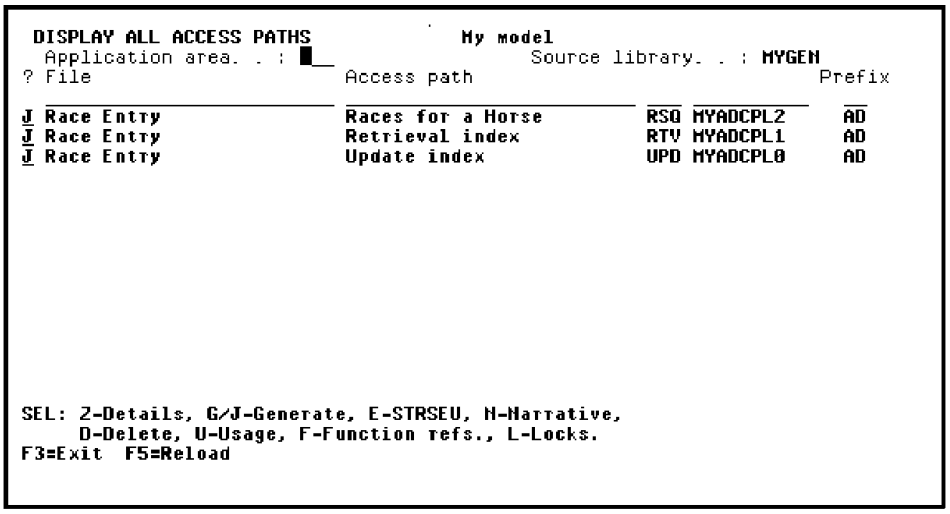
Press Enter.

Note: The Display All Access Paths panel also lets you perform many design, control, and generation tasks for one or more access paths.

Select all of the existing access path designs for batch generation and compilation by typing a **J** in the Subfile selector next to each access path in the list as shown in the following example:

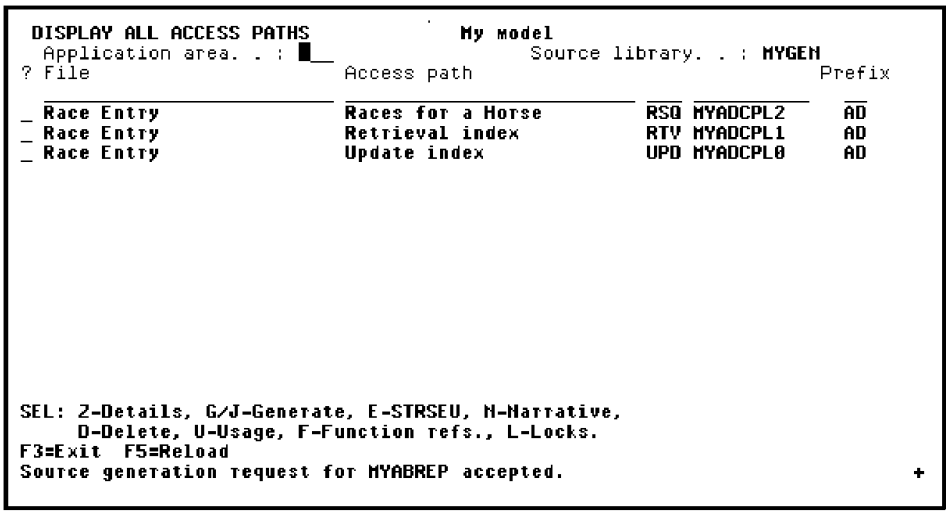


Press Roll Up to display the next screen of access paths so you can select all remaining access paths with a **J** as shown in the following example:



Press Enter.

When the process is complete, the Display All Access Paths panel will be redisplayed with messages at the bottom of the panel. The messages will state that the source generation requests have been accepted. A panel with messages is shown next:



Press F3 to return to the Display Services Menu.

Limitations:

When you to take the G / J option to generate the access paths from the Display All Access Paths panel or take the G / J option to generate the access paths from the Edit File Details panel or take option 14 / 15 from the Edit Model Object List panel against a *DDL-based access path and the access path has either of the four DDL limitations, the generation is prevented. The access path source is not generated and no entry is added to the job list.

- The current implementation of the DDL generation mode is not valid for the following cases:
  - Access paths that have virtual fields
  - SPN access path
  - QRY access path
  - Multi-member files

  Workaround for Virtual Fields, SPN, and QRY Access Paths: If the earlier generation mode is *DDS, revert to it and regenerate the access path. You need not regenerate the functions that use this access path. If you want to have an SQL type database, regenerate the access path using *SQL generation mode. The functions using this access path must be regenerated.

  Workaround for Multi-Member Files: If you want to have more than one member for the access paths, revert to *DDS generation mode.

Note: If you want to change an access path, which is previously defined as *DDS with a MAXMBR compiler override, to *DDL, you must revert to *DDS generation mode and must remove the compiler override, and then change back to *DDL generation mode.

Generate External Functions Source Code

Only external functions need to be generated and compiled. External functions can be identified by the source member name found in the GEN name column; internal functions show *N/A in this column.

List just the external functions in your design model by typing *****EXT in the Type column on the selection line as shown in the following example:

```
  DISPLAY ALL FUNCTIONS              My model
    Application area. :   ___                    Source library:   MYGEN
 ? File                      Function                 Type          GEN name
   ___________________   ____________________________  *EXT___     __________
_  Course           Change Course         CHGOBJ    *N/A _  Course           Create
Course
CRTOBJ      *N/A
_  Course                Delete Course              DLTOBJ      *N/A
_  Course                Edit Course                EDTFIL      MYACEFR

_  Course                Select Course              SELRCD      MYABSRR
_  Horse                 Change Horse               CHGOBJ      *N/A
_  Horse                 Create Horse               CRTOBJ      *N/A
_  Horse                 Delete Horse               DLTOBJ      *N/A
_  Horse                 Edit Horse                 EDTFIL      MYAEEFR
_  Horse                 Select Horse               SELRCD      MYAISRR
_  Horse                 Select Mares               SELRCD      MYAJSRR
_  Horse                 Select Stallions           SELRCD      MYAKSRR
_  Jockey                Change Jockey              CHGOBJ      *N/A
_  Jockey                Create Jockey              CRTOBJ      *N/A
_  Jockey                Delete Jockey              DLTOBJ      *N/A        +
SEL: Z=Dtls   P=Parms  N=Narr    F=Action diagram   S=Device Design  T=Structure
     A=Acp    G/J=Gen  E=STRSEU  L=Locks  D=Delete  U=Usages  3=Doc  H=Gen HTML
 F3=Exit   F5=Reload
```

Proceed by selecting all functions and initiating the batch processing as you did for the access paths.

Program Compilation

Program compilation is the second part of the third phase of development. You will learn how to call your compiled applications (programs) and test them by entering data.

When you submit a request for generation, compilation, or both, the CA 2E generator automatically generates a job list. The same job list controls generation and compilation. You can review this job list during generation to monitor the process and edit the job list.

Source is produced and placed in the appropriate source file in the generation library associated with your CA 2E design model, and then the generated source is compiled.

To begin, select the Submit model create request (YSBMMDLCRT) option as shown in the following example, and press Enter.

```
 DISPLAY SERVICES MENU                My model


Generation           1. Submit model create request (YSBMMDLCRT)

                     2. convert model data menu

                     3. Job list menu


Documentation        6. Documentation menu

                     7. Convert model panel designs (YCVTMDLPNL)


Model                8. Display all access paths

                     9. Display all functions

                    10. Display model values (YDSPMDLVAL)

                    11. Edit model profile (YEDTMDLPRF)

                    12. Work with model lists (YWRKMDLLST)

                    13. Edit model list (YEDTMDLLST *SESSION)

                    14. Impact analysis menu


Change Control      21. Go to Change Management Option (CM) menu
```

```
                Option: 1  (press F4 to prompt commands)


F3=Exit    F6=Messages    F8=Submitted jobs  F9=Command line  F10=Display job log
```

Note: CA 2E supplies default parameter values for the YSBMMDLCRT command based on your model profile and options you specified when you created your model. You can override these defaults by pressing F4 instead of Enter to prompt the command.

CA 2E displays a list of the source members to be generated and compiled. Each member has either GEN or CRT next to it to indicate whether the member has been submitted for generation or compilation. At this point all the functions and access paths should show GEN as shown in the following example:

```
 SUBMIT MODEL GENERATIONS & CREATES.  My model

                                                          GENLIB: MYGEN
? Member     Type Act Status  Text
_ MYABREP    PF   GEN         Course                    Physical file
_ MYACREP    PF   GEN         Race                      Physical file
_ MYADCPP    PF   GEN         Race Entry                Physical file
_ MYAEREP    PF   GEN         Horse                     Physical file
_ MYAFREP    PF   GEN         Jockey                    Physical file
_ MYABREL0   LF   GEN         Course                    Update index
_ MYACREL0   LF   GEN         Race                      Update index
_ MYADCPL0   LF   GEN         Race Entry                Update index
_ MYAEREL0   LF   GEN         Horse                     Update index
_ MYAFREL0   LF   GEN         Jockey                    Update index
_ MYABREL1   LF   GEN         Course                    Retrieval index
_ MYACREL1   LF   GEN         Race                      Retrieval index
_ MYADCPL1   LF   GEN         Race Entry                Retrieval index      +

SEL: G-Rqs GEN, C-Rqs CRT, E-STRSEU, D-Drop, JOB(1-DSP, 4-HLD, 6-RLS, 9-CNL)
F3=Exit  F5=Reload  F6=Msgs  F8=Submitted jobs  F9=Command line  ENTER-Submit
```

Press Roll Up until you see the bottom of the list, and then Press Enter to submit the job list.

After confirming the list of objects, you will see the following series of messages at the bottom of the panel:

- Job YGENSRC is being prepared.
- Existing objects are being deleted.
- Joblist successfully processed.

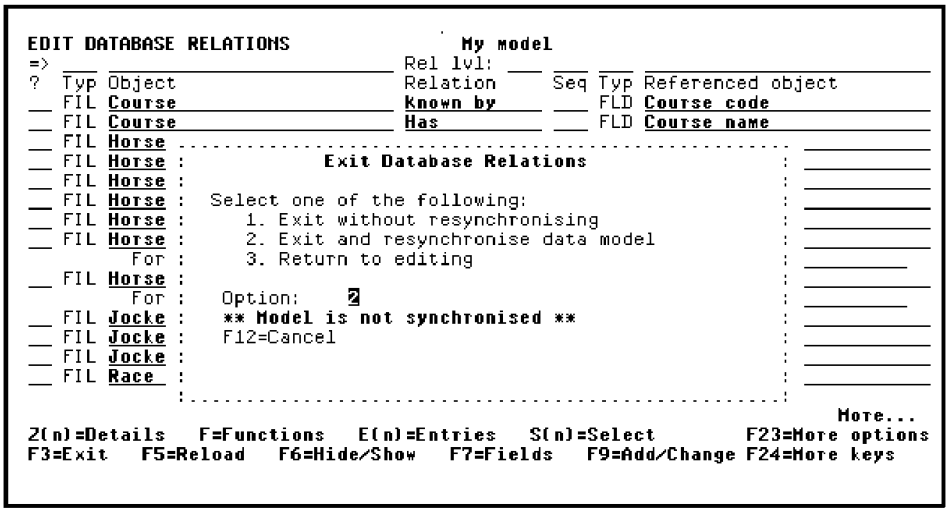
In batch processing, the generations, compilations, or both take place in the background. You may continue to specify new objects (functions, access paths) while the batch is processing.

Before calling your program, you must use the Convert Condition Values (YCVTCNDVAL) command to convert the values that are entered into status fields. The values you defined for status fields are moved from the model library to the condition values list database file in the generation library.

Horse gender is an example of a status field. We specified the valid values for this field in our model library and those values are placed in the generation library database when we run the Convert Condition Values (YCVTCNDVAL) command. In this case, the end user running the application will then be able to select either M or F as valid values for Horse gender.

When you exit this session, if you have added or changed any files, fields, or relations in the current session, you may want to resynchronize the model. This causes all the relations to be resolved into entries. Only users of enter *DSNR can resynchronize a model.

Select the desired option, as shown in the following example, and press Enter:



Testing Your Programs

You can call your compiled programs from any command entry line by using the i OS CALL command to invoke your program. From within your model, you can display a command entry line by pressing F9 from the Display Services menu.

Note: If you do not know the name of your program, you can obtain it from the Edit Function Details panel or the Display all functions option on the Display Services Menu.

When you call your program you need to specify a dummy *Return code parameter. All CA 2E programs require a dummy parameter to be passed to the program (‘ ‘ or ‘’). This return code can be used to communicate between programs in more complex applications.

Enter the program name and return code, and press Enter. The following example calls the program MYAEEFR.

```
MAIN                          2E Main Menu

Level . :   1

                                                          System:     2EDV1

Select one of the following:


 Design Model             1. Display Designer (*DSNR) menu

                          2. Display Programmer (*PGMR) menu

                          3. Display User (*USER) menu


                          8. Work with Model Object Lists

                          9. Change to work with another model


 Commands                50. 2E commands in alphabetical order


                         51. Commands to set up or alter a model

                         52. Commands to copy a model

                         53. Commands to create an application

                         54. Commands to document a model
```

```
                                                                    More. . .

Selection or command

===>  call myaeefr **_____________________________________________________

_______________________________________________________________________

F3=Exit  F6=Messages  F8=Rev retrieve  F9=Retrieve  F10=Cmd Entry F14=Sbm jobs
```

Note: To test complex programs, you can use the CA 2E Call a Program (Y2CALL) command. This command loads your model and determines the parameters required by an external function directly from details contained in the model.

You can provide values for all input-capable fields and you can reuse these values for subsequent calls. You can also retrieve and display output parameters when the called program ends.