16.070

Introduction to Computers & Programming

Ada

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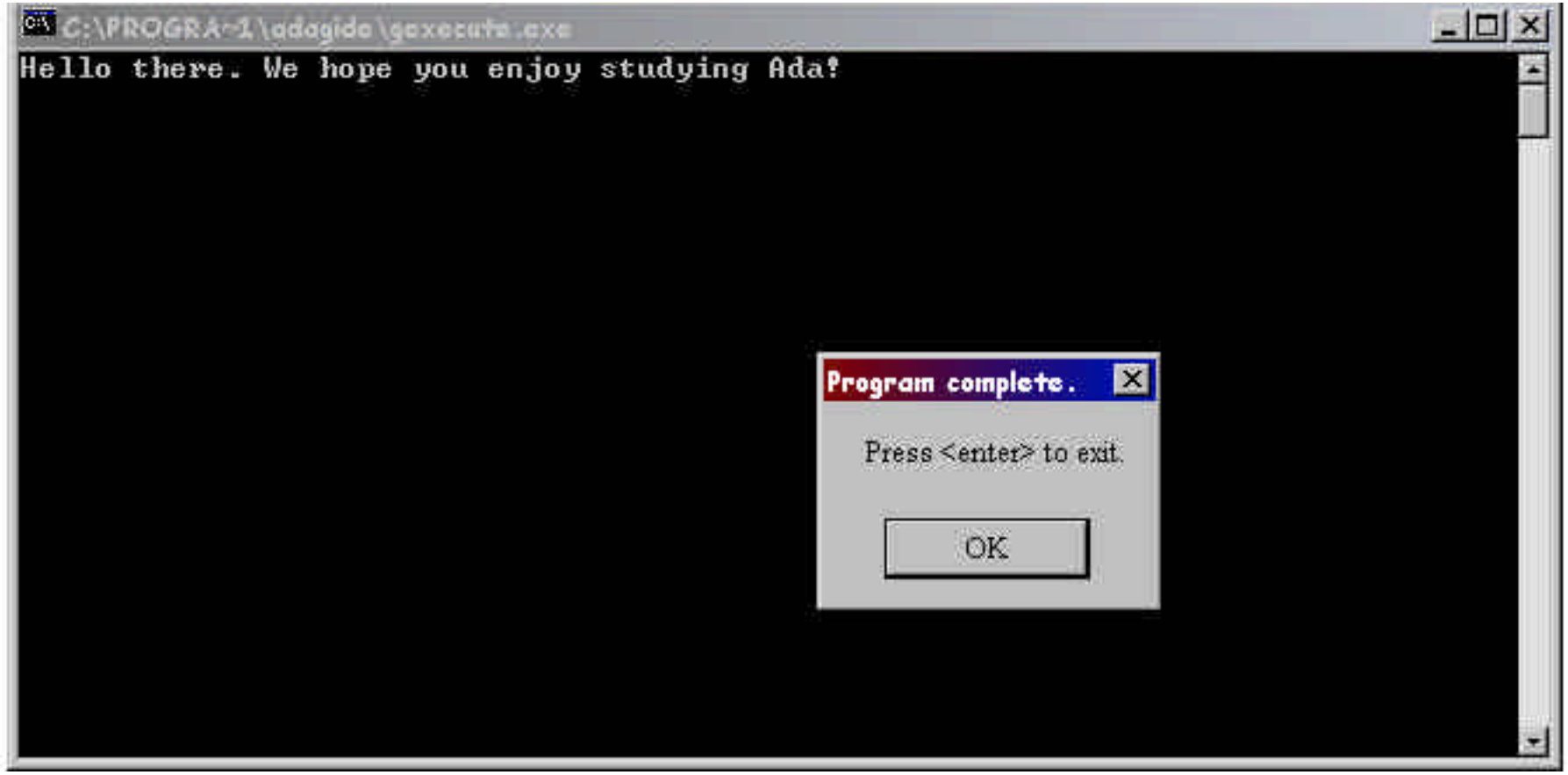
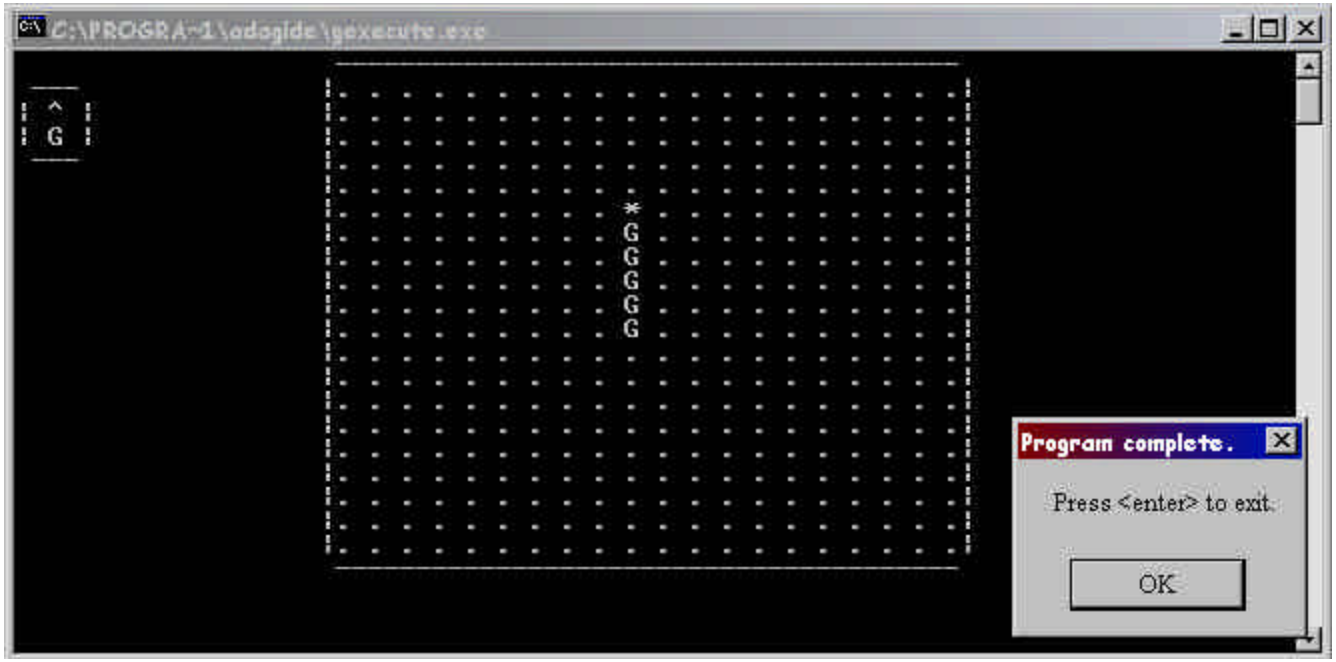
First program

- Display a message: “Hello there. We hope you enjoy studying Ada!”
- Pseudo code: `put (Hello there. We hope you enjoy studying Ada!)`

```
WITH Ada.Text_IO;          -- declare the package
PROCEDURE Hello IS
------------------------------------------------------------
--| A very simple program; it just displays a greeting.
--| Author: Michael Feldman, The George Washington University
--| Last Modified: June 1998
------------------------------------------------------------
BEGIN -- Hello

  Ada.Text_IO.Put(Item => "Hello there. ");
  Ada.Text_IO.Put(Item => "We hope you enjoy studying Ada!");
  Ada.Text_IO.New_Line;

END Hello;
```


C:\PROGRA~1\adagide\gexecute.exe
Hello there. We hope you enjoy studying Ada!
Program complete.
Press <enter> to exit.
OK

```
WITH Spider;
PROCEDURE Walk_Line IS
------------------------------------------------------------
--| Walk line with spider
--| Author: M. B. Feldman, The George Washington University
--| Last Modified: July 1998
------------------------------------------------------------
BEGIN -- Walk_Line
  Spider.Start;

  Spider.Step;
  Spider.Step;
  Spider.Step;
  Spider.Step;
  Spider.Step;

  Spider.Quit;

END Walk_Line;
```



The Spider Package (`spider.ads`)

- A package is a way to encapsulate, or group, a set of related operations.
  - Divided into 2 parts
    - Specification .ads
      "table of contents"
    - Body .adb
      actual program segments
- Standard Ada packages are "built in", i.e., provided by the compiler
  - Standard (+, -, …, characters)
  - Character (Is_upper, To_Lower,…)
  - Numerics (Sqrt, Log, …)
  - Text_IO (get, put, open, …)
  - …

AdaGIDE - [spider.ads]

File Edit Compile Run Tools Window Help

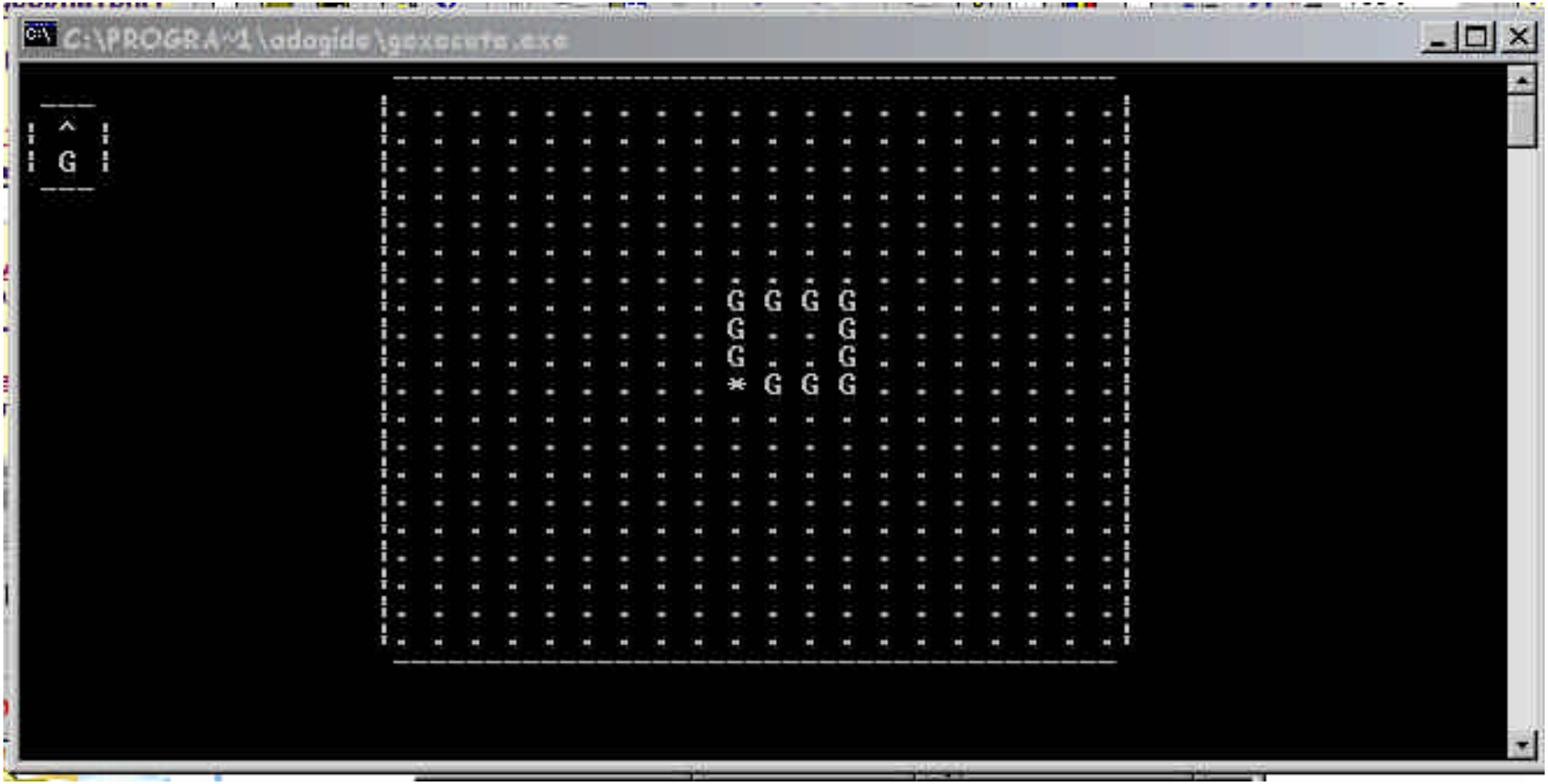
```
PACKAGE Spider IS
------------------------------------------------------------------
--| This package provides procedures to emulate "Spider"
--| commands. The spider can move around
--| the screen drawing simple patterns.
--| Author: John Dalbey, Cal Poly San Luis Obispo, 1992
--| Adapted by M. B. Feldman, The George Washington University
--| Last Modified: December 1998
------------------------------------------------------------------
  -- These are the spider's simple parameterless methods

  PROCEDURE Start;
  -- Pre:  None
  -- Post: Spider's room appears on the screen
  --   with spider in the center.

  PROCEDURE Quit;
  -- Pre:  None
  -- Post: End the drawing

  PROCEDURE Step;
  -- Pre:  None
  -- Post: Spider takes one step forward in the direction it is facing.
  -- Raises: Hit_the_Wall if spider tries to step into a wall.

  PROCEDURE TurnRight;
  -- Pre:  None
  -- Post: Spider turns 90 degrees to the right.

  -- now some types, and methods that use the types

  TYPE Directions IS (North, East, South, West);
  TYPE Colors     IS (Red, Green, Blue, Black, None);
  SUBTYPE Steps IS Integer RANGE 1..20;

  PROCEDURE Face (WhichWay: IN Directions);
  -- Pre:  WhichWay has been assigned a value
  -- Post: Spider turns to face the given direction.
```

The Spider Package (`spider.adb`)

```
PROCEDURE Start IS

BEGIN
DrawRoom;
CurrentColumn := 10; -- these are in the spider's view
CurrentRow := 11;
Heading := North;
ChangeColor(NewColor => Green);
ShowSpider;
ShowDirection;
RandomSteps.Reset(Gen => GSteps);
RandomColors.Reset(Gen => GColors);
RandomDirections.Reset(Gen => GDirections);

END Start;
```

Spider walk_box

```
WITH Spider;
PROCEDURE Walk_Box IS
----------------------------------------
--| Walk 4 x 4 box with spider
--| Author: M. B. Feldman, The GWU
--| Last Modified: July 1998
----------------------------------------

BEGIN -- Walk_Box

  Spider.Start;

  Spider.Step;
  Spider.Step;
  Spider.Step;
  Spider.TurnRight;

  Spider.Step;
  Spider.Step;
  Spider.Step;
  Spider.TurnRight;

  Spider.Step;
  Spider.Step;
  Spider.Step;
  Spider.TurnRight;

  Spider.Step;
  Spider.Step;
  Spider.Step;
  Spider.TurnRight;

  Spider.Quit;

END Walk_Box;
```


C:\PROGRA~1\adagide\gexecute.exe
^
G

Algorithm with Single Loop

- Algorithm for drawing box
  1. Repeat steps a and b 4 times
     a. Take 3 steps forward
     b. Turn right
- A repetition is usually called a loop
  - Use an Ada control structure called the `FOR` construct:
    `FOR Side IN 1..4 LOOP`
    and
    `END LOOP;`

```
WITH Spider;
PROCEDURE Draw_Box_with_1_Loop IS
---------------------------------------
--| Draw 4 x 4 box with spider - use loop
--| Author: M. B. Feldman, The GWU
--| Last Modified: July 1998
---------------------------------------
BEGIN -- Draw_Box_with_1_Loop
  Spider.Start;
  Spider.ChangeColor(NewColor =>
                     Spider.Red);
  FOR Side IN 1..4 LOOP
Spider.Step;
Spider.Step;
Spider.Step;
Spider.TurnRight;
  END LOOP;
  Spider.Quit;
END Draw_Box_with_1_Loop;
```

Reading and Writing Numbers

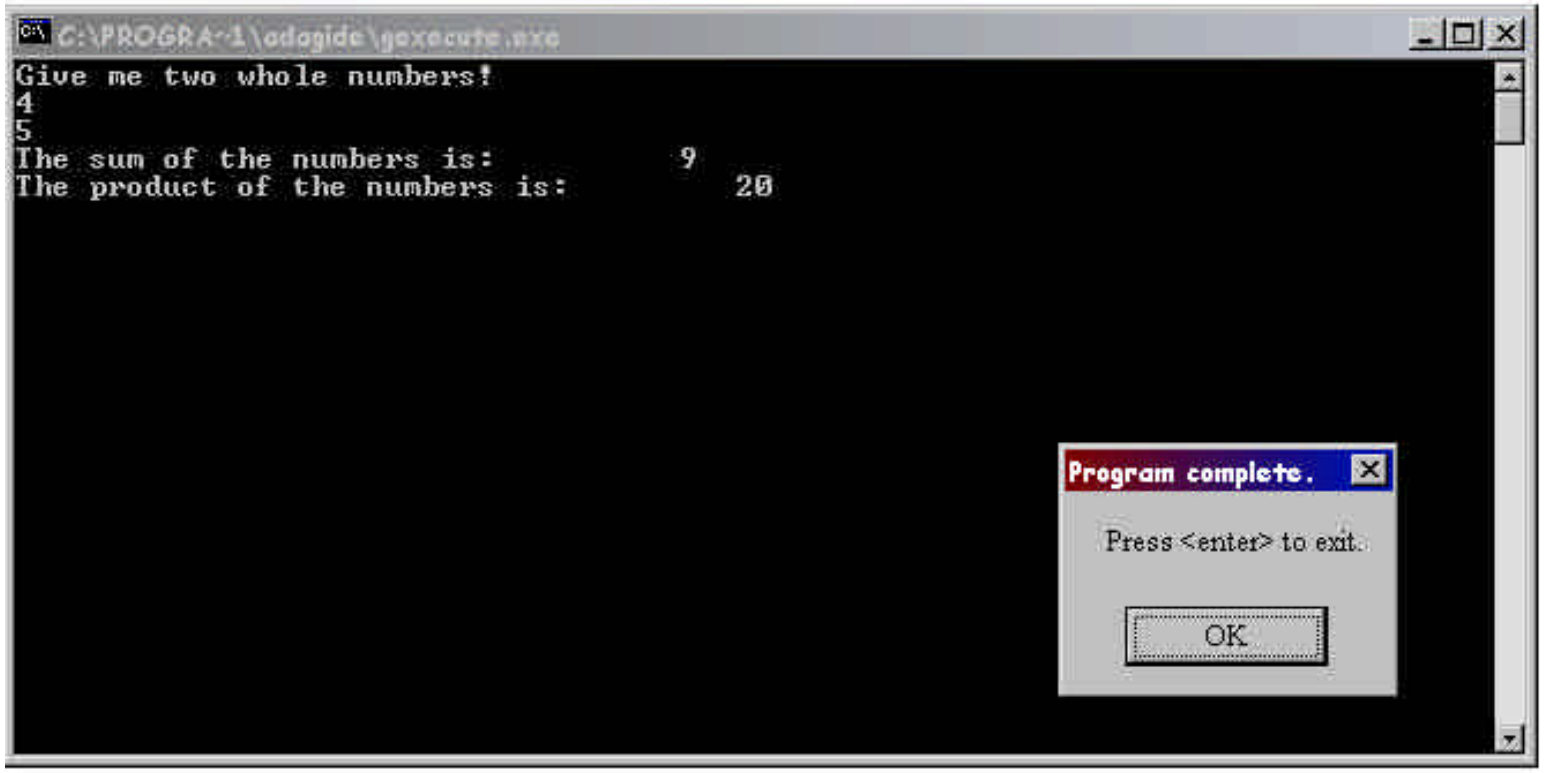
- Calculate the sum and product of two numbers
- Algorithm:
  - Get the 2 numbers
    - Ask for the 2 numbers
    - Get number1
    - Get number2
  - Calculate and print the sum
    - Print “The sum is “
    - Print (number1 + number2)
  - Calculate and print the product
    - Print “The product is “
    - Print (number1 * number2)

- Pseudo code

```
Number1: number
Number2: number

Put (give me two whole
      numbers)
Get (number1)
Get (number2)

Put (the sum of the
      numbers is )
Put (number1 + number2)

Put (the product of the
      numbers is )
Put (number1 * number2)
```

sum_prod

```
-------------------------------------------------------
-- sum_prod - sum and product, Skansholm #2.4.2
-------------------------------------------------------
with Text_Io; -- specify packages we depend on
use Text_Io;
procedure Sum_Prod is
   -- declare integer I/O package
   package Int_Io is new Text_Io.Integer_Io(Integer);
   use Int_Io;
   -- declare any constants and variables required
   Number1,  Number2 : Integer; -- numbers used
begin -- sum_prod
   -- ask user for numbers and read them
   Put_Line("Give me two whole numbers!");
   Get(Number1);
   Get(Number2);
   -- display sum and product of numbers
   Put("The sum of the numbers is:");
   Put(Number1+Number2);
   New_Line;
   Put("The product of the numbers is:");
   Put(Number1*Number2);
   New_Line;
end Sum_Prod;
```


C:\PROGRA~1\odogide\gexecute.exe
Give me two whole numbers!
4
5
The sum of the numbers is: 9
The product of the numbers is: 20
Program complete.
Press <enter> to exit.
OK

Alternative solution

```
with Text_Io; use Text_Io;

procedure Sum_Prod is
   -- declare integer I/O package
   package Int_Io is new Text_Io.Integer_Io( Integer );
   use Int_Io;

   -- declare any constants and variables required
   Number1, Number2, Total, Product : Integer;

begin -- sum_prod
   -- ask user for numbers and read them
   Put ( "Please enter the first number ");
   Get ( Number1 );   Skip_Line;
   Put ( "Please enter the second number ");
   Get ( Number2 );   Skip_Line;

   -- display sum and product of numbers
   Total := Number1 + Number2;
   Product := Number1 * Number2;
   Put("The sum of the numbers is:");
   Put(Total, Width=>7);   New_Line;
   Put("The product of the numbers is:");
   Put(Product, Width=>3);   New_Line;
end Sum_Prod;
```

Layout conventions

one statement (thought) per line

break long lines into readable segments

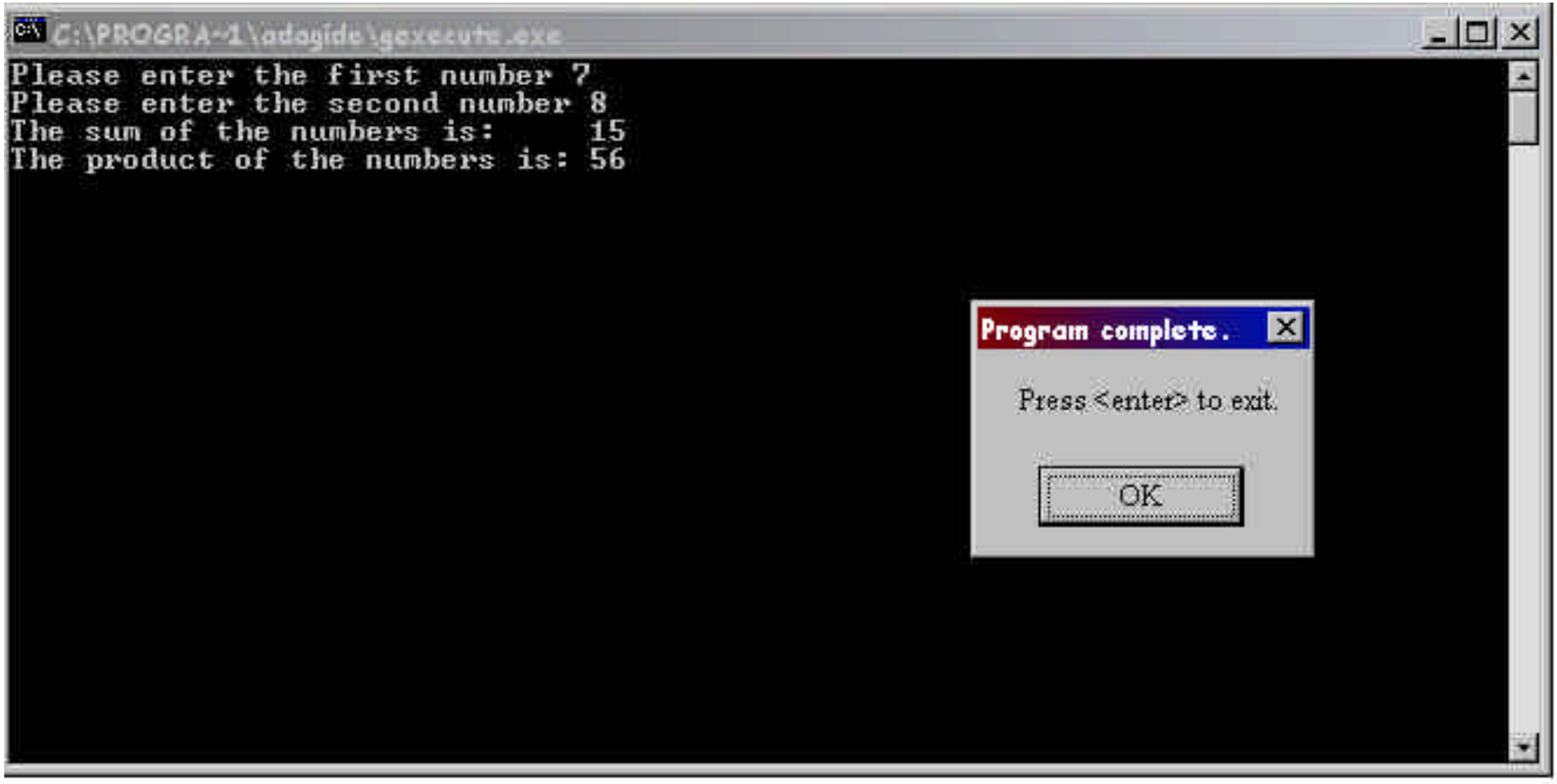
indent lines to show different parts of the program

blank lines separate parts of the program

comments/header to help readers understand the program

Comments

- Lines starting with -- are ignored by the compiler. Only there to help someone reading the program
- Good comments:
  - are always correct and up to date
  - conform to usual conventions of prose
  - provide information not immediately obvious
  - describe the intended effect of (part of) the program
- Minimum comments in **any** program:
  - the name of the program (name)
  - who wrote it and when (author & date written)
  - description of what the program does (purpose)
  - description of any constants or variables
  - description of purpose of each segment of code
  - assumptions made (precondition / postcondition)


C:\PROGRA~1\adagide\gexecute.exe
Please enter the first number 7
Please enter the second number 8
The sum of the numbers is: 15
The product of the numbers is: 56
Program complete.
Press <enter> to exit.
OK

- Good programs
  - Meet specification
    - Verifiable, dependable
    - Correct
  - Natural
    - Abstraction, modularization, encapsulation
  - Efficient
  - Readable/”elegant”

Program structure and layout

```
-----------------------------------
-- sum_prod - sum and product …
-- author: Joe B
-- last modified: 2/9/03
-----------------------------------
with ...;
use ...;
   procedure program_name is
      declare I/O packages
      declare constants & variables used
begin -- program_name
   statements
end program_name ;
```

Reserved words

- Reserved words cannot be used for any other purpose than their special meaning.
  - `abort abs accept access all and array at` **`begin`** `body case constant declare delay delta digits else elsif` **`end`** `entry exception exit for function generic goto if in` **`is`** `limited loop mod new not null of or others out` **`package`** `pragma private` **`procedure`** `raise range record rem renames return reverse select separate subtype task terminate then type` **`use`** `when while` **`with`** `xor`
- Pre-defined words have standard pre-defined meaning. Their meaning can be changed ... with care ... **but don't**!
  - `BOOLEAN CHARACTER CLOSE CREATE DELETE FALSE FLOAT` **`GET`** **`INTEGER`** `NATURAL` **`NEW_LINE`** `OPEN` **`PUT`** `PUT_LINE POSITIVE READ RESET` **`SKIP_LINE`** `STRING TEXT_IO TRUE WRITE`