

Université d'Ottawa  
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technologie de l'information



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L'Université canadienne  
Canada's university

University of Ottawa  
Faculty of Engineering

School of Information  
Technology and Engineering

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**GNG1506/1106 Examen de mi-session / Midterm Examination**

**October 27<sup>th</sup>, 2006**

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## Solution

**Time allowed: 90 minutes**

**Closed book examination**

**Non-programmable calculators are allowed**

**Attempt all questions**

**Questions carry the weights indicated**

**The total number of points for the examination is 64**

**Answer the questions in the spaces provided**

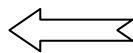
**La version française se trouve à l'endos des pages.**

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**Name:** \_\_\_\_\_ **Student Number:** \_\_\_\_\_

Please circle your section:      **A** (Dr. Schriemer)      **B** (G. Arbez)

|         |  |
|---------|--|
| Part 1: |  |
| Part 2: |  |
| Part 3: |  |
| Part 4: |  |
| Total:  |  |



Do not write in this box!

## Part 1 – Short Answer Questions

2 marks each

Please provide short answers to each question.

(a) Provide the definition for a computer variable.

**The computer variable is a location in memory that contains a value. The location has an address and the variable name corresponds to this address.**

(b) Circle any of the following terms that relate directly to the looping structure:

|                     |                          |                           |
|---------------------|--------------------------|---------------------------|
| <b>Repeat while</b> | variable                 | argument                  |
| Function call       | #define                  | <b>Logical expression</b> |
| prototype           | <b>Instruction block</b> | if-else                   |

(c) What is the prototype of the following function?

```
int larComFac(int top, int bottom)
{
    int ctr=top;
    /* Loop until the LCF is found. */
    while( ((top%ctr != 0) || (bottom%ctr != 0)) && ctr > 1)
        ctr--;
    return ctr;
}

int larComFac(int top, int bottom); /*OR*/
int larComFac(int, int);          /* OR */
larComFac(int top, int bottom);  /* OR - but not good style */
larComFac(int, int);             /* not good style */
```

(d) What is output by the following program?

```
#define CONST 2000
void main()
{
    int i;
    float a=3.9;
    int z=2000853;

    /* a) */ i=z%CONST;    printf("a) %d\n", i);
    /* b) */ a=10+6/3+1;  printf("b) %f\n", a);
}

a) 853
b) 13.00000
```

(e) Which conversion specifier tells printf to print a real value? %f

(f) Consider the following function call:

```
.  
.   
int mat[2][3];           /*the variable declaration*/  
.   
.   
funcName(mat[2], 3);    /*the function call*/
```

Is the first argument in the argument list passed to the function by value or by reference?  
**Pass by reference (it is the address of the row that is passed).**

## Part 2 – Debugging

8 marks

Find the errors in the C code below that will yield a failure to compile. Identify all compilation errors by line number and explain what is wrong.

|    |   |
|----|---|
| 1  | #include <stdio>                                |
| 2  | #define PI 3.1415                               |
| 3  | int main()                                      |
| 4  | {   |
| 5  | /* Variable declarations and initializations */ |
| 7  | float radius, diameter, circumference;          |
| 8  | float z = 1.0; y; w=3.5;                        |
| 9  |   |
| 10 | printf("Enter the value of radius: /n");        |
| 11 | scanf("%d",&radius);                            |
| 12 | diameter = 2*radius;                            |
| 13 | circumference = PI*diameter;                    |
| 14 | area_of_circle = PI*radius*radius               |
| 15 | return(0);                                      |
| 16 | }   |

**Answer:**

**Line 1 – missing .h in stdio.h – file will not be found, (2 marks)**

**Line 8 – the two semi-colons are not valid separators, should be commas, (2 marks – 1 mark per semi-colon)**

**Line 14: area\_of\_circle is not declared; add declaration to line 7 or 8. (2 marks)**

**Line 14 – missing semi-colon at the end of the instruction “.....radius\*radius;”. (2 marks)**

### Part 3 – Computing Concepts

a) 15 marks; b) 5 marks

For the program on the following page, note or assume the following:

- The matrix is located at address 10222; that is, its first element is stored at address 10222;
- The function `print1D` is called twice, so the block of working memory associated with the function is given twice, since the contents of memory may be different;  
\*\*you will need to explicitly state in working memory what parameters/variables are used by the function, e.g. see (a) below for form. \*\*
- Successive calls to `rand( )` returns the following values: 41, 18467, 6334, 26500, 18169, 15724, 11478, 29358, 26962, 24464

- (a) On the next page, show how the contents of the working memory are changed by the execution of the program. In the working memory table, record successive assignments to a variable/parameter as follows:

Variable name

- (b) On the terminal screen below, show the output of the program, i.e., what is printed on the screen.

Marking :  
.5 for each value for total of 3  
2 points for formatting

```
6 12 9
5 14 9
```

# Program Me

```

#include <stdio.h>
#include <stdlib.h>
#define NROWS 2
#define NCOLS 3
void fill_random(int[][][], int);
void print1D(int[],int);
/*-----
41, 18467, 6334, 26500, 18169, 15724, 1
int main()
{
    int a2D[NROWS][NCOLS];
    int ix;

    fill_random(a2D,NROWS);
    for(ix=0 ; ix <= NROWS-1 ; ix++
        print1D(a2D[ix],NCOLS);

    system("PAUSE");
    return 0;
}
/*-----
void fill_random(int mat[][][NCOLS]
{
    int rix, cix; /* index into r
    for(rix = 0 ; rix <= numRows-1
        for(cix = 0 ; cix <= NCOLS-
            mat[rix][cix] = 5 + ran
}
/*-----
void print1D(int arr[], int num)
{
    int ix; /* index into array *
    for(ix = 0 ; ix <= num-1; ix++
    {
        printf("%d ",arr[ix]);
    }
    printf("\n");
}
/*-----*/

```

Marking :

For correct contents :

Main :

a2D array : 1 mark

ix : 1 mark

fill\_random

mat : 2 marks

numRows : 1 mark

rix : 1 mark

cix : 1 mark

print1D first call

arr: 2 mark

num: 1 mark

ix: 1 mark

print1D second call

arr: 2 mark

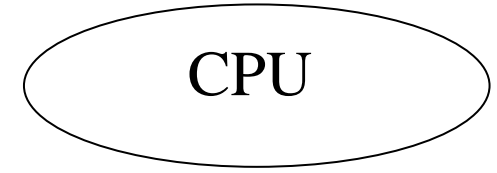
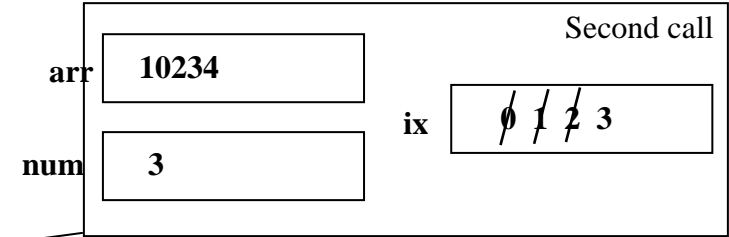
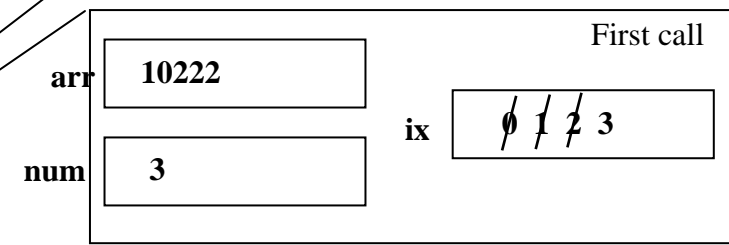
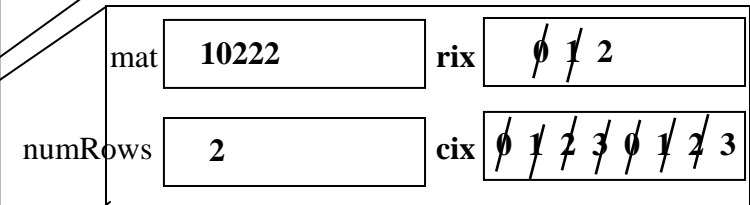
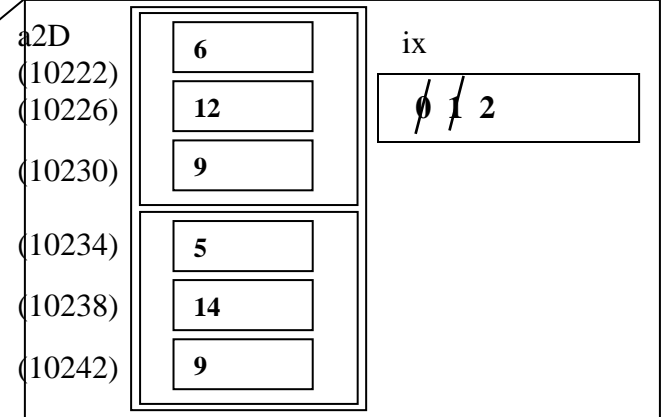
num: 1 mark

ix: 1 mark

Give partial marks for partial answers:

- For Print1D half marks for providing correct variables and half marks for contents
- For indices, deduct .25 if missing last value
- Etc.

# Working Memory



## Part 4 – Problem Solving.

a) 3 points; b) 3 points; c) 4 points; d) 3 points; e) 11 points

Your project is to provide a software tool to compute what amount  $A$  will be generated when an amount  $P$  is invested (the principal) at an annual interest rate,  $i$ , for a number  $n$  of years. The value  $i$  is a percentage divided by 100 (e.g. 10% gives a value of 0.1 for  $i$ ).

Provide two options to the user:

- i. the first option simply outputs the amount  $A$  along with the values  $P$ ,  $i$ , and  $n$  provided by the user;
- ii. the second option prints a table on the screen to show how the amount  $A$  progresses each year (from year 1 to year  $n$ ) also with the values  $P$ ,  $i$ , and  $n$  provided by the user.

The following formula relates  $A$ ,  $P$ ,  $i$ , and  $n$ :  $A = P(1+i)^n$

a) **Step 1** – *Statement of the problem*: provide a clear description of the problem to be solved.

**Answer:**

**Develop a software tool that reads from the user three values: a principal amount  $P$ , an annual interest rate  $i$ , and a number of years  $n$ .**

1 mark

**The main function of the tool is to calculate the total amount  $A$  generated when the principle  $P$  is invested for  $n$  years at an interest rate  $i$ .**

1 mark

**Two output options are given to the user. A first option outputs the amount  $A$  with the three values provided by the user. The second option outputs a table that shows how  $A$  increased from year 1 to  $n$ .**

1 mark

b) **Step 2a** – *Gathering of Information*: List all relevant information required for solving the problem.

**Answer:**

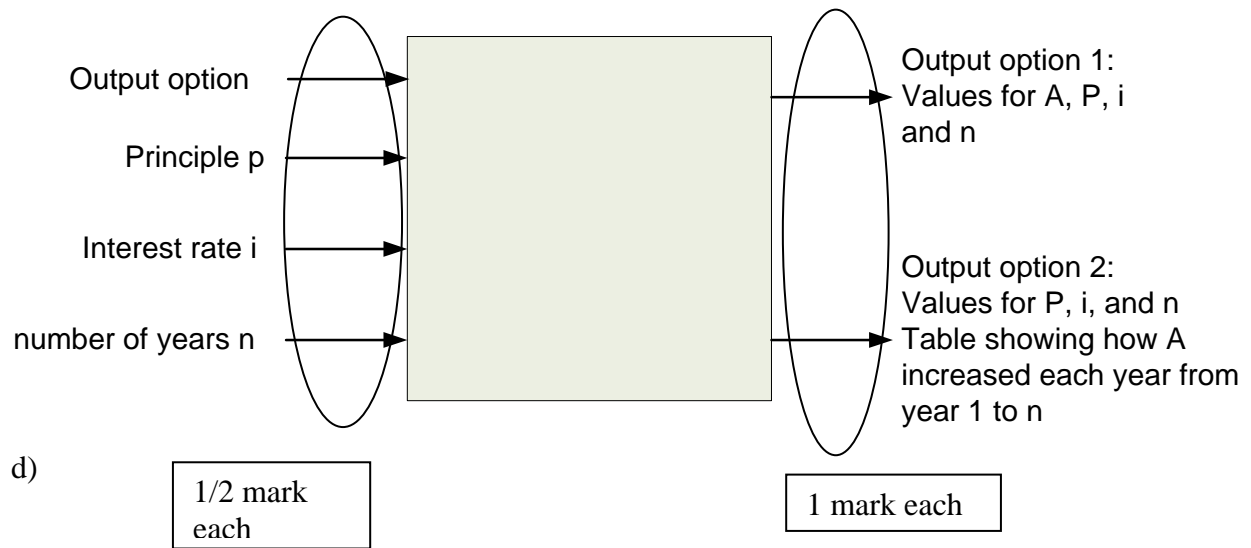
The amount **A** can be calculated from **P**, **i** and **n** using  $A = P(1+i)^n$ .

3 marks – just formula is OK

The same formula can be used to compute how to compute how **A** increases from year to year: that is:  $A_m = P(1+i)^m$ , here **m** is varies from 1 to **n**, and **A<sub>m</sub>** represents the value of **A** at year **m**.

c) **Step 2b** – *Input and Output Description*: Give a diagram that shows all inputs and outputs of the software tool.

**Answer:**



**Step 3a – Test Cases:** Give two test cases, one for each the two options provided to the user that shows the output produced by the software tool. Give a third test case that shows how the software tool reacts to invalid input.

**Answer:**

**Test case 1: Option 1 with values for P = 1000, i=0.10, n=5**

1 mark

**Amount A will be 1610.51 when 1000.00 is invested for 5 years at an interest rate of 0.10.**

**Test case 2: Option 2 with values P = 1000, i=0.10, n=5**

1 mark

**Principal 1000.00 is invested for 5 years at a rate of 0.10.**

| <b>Year</b> | <b>Amount A</b> |
|-------------|-----------------|
| <b>1</b>    | <b>1100.00</b>  |
| <b>2</b>    | <b>1210.00</b>  |
| <b>3</b>    | <b>1331.00</b>  |
| <b>4</b>    | <b>1464.10</b>  |
| <b>5</b>    | <b>1610.51</b>  |

**Test case 3: User enters value -1000 for P.**

1 mark

**Please enter a value for the principal P: -1000**

**Invalid value for P: -1000**

**Please enter a value for the principal P:**

e) **Step 3b** – *Algorithm design*: Use the guidelines below to design an algorithm for your tool. The algorithm shall be described in pseudocode. Your pseudocode must contain clear descriptions of every step that would appear in the final program coded with a programming language. **DO NOT USE C CODE.**

- In carefully written pseudocode, design and provide a subprogram that computes the amount  $A$  from given values for  $P$ ,  $i$ , and  $n$ .
- In carefully written pseudocode, design and provide two subprograms that generate the output to the screen, one subprogram for each of the options.
- In carefully written pseudocode, design and provide a main program that repeatedly performs the following steps:
  - a. requests the input from the user,
  - b. presents a menu giving options for generating output,
  - c. and generates output using the above subprograms according to the selection made by the user.

You will need to define how the user can terminate the software tool.

**Answer:**

*Main subprogram*

*Assign TRUE to flag*

*Repeat*

*Repeat*

*Print "Please enter a value for the principal P: "*

*Read value into p*

*if p less than or equal 0*

*Print "Invalid value for P: ", p*

*While p less than or equal 0*

*Repeat*

*Print "Please enter a value for the principal i: "*

*Read value into i*

*if i less than or equal 0*

*Print "Invalid value for i: ", i*

*While i less than or equal 0*

*Repeat*

*Print "Please enter a value for the principal n: "*

*Read value into n*

*if n less than or equal 0*

*Print "Invalid value for n: ", n*

*While n less than or equal 0*

*Repeat*

*Print "1) Print final amount"*

*Print "2) Table of yearly increases"*

*Print "3) Exit"*

*Read value into answer*

*If answer less than 1 or answer greater than 3*

*Print "Invalid choice ", answer*

*While answer less than 1 or answer greater than 3*

*If answer equals 3*

*Assign False to flag*

*Otherwise if answer equals 1*

*printFinalAmount(p, i, n)*

*Otherwise*

*printTableIncreases(p, i, n)*

*While flag is TRUE*

*Print "Terminating"*

1/2 mark for read;  
1/2 mark for validity check

1/2 mark for read;  
1/2 mark for validity check

1/2 mark for read;  
1/2 mark for validity check

1/2 mark for read;  
1/2 mark for validity check

1 mark for flag;  
1/2 mark for function call 1  
1/2 mark for function call 2

1 mark  
for loop

*printFinalAmount(p, i, n)*

*Assign computedA(p, I, n) to a*

*Print "Amount A will be ", a, " when ", p, " is invested for ", n,  
" years at an interest rate of ", i*

1/2 mark for header  
1/2 mark for print

*printTableIncreases(p, i, n)*

*Print "Principal ", p, " is invested for ", n, " years at an interest rate of ", i*

*Print "Year                      Amount"*

*Assign 1 to ctr*

*Repeat while ctr is less than or equal to n*

*Print ctr, "                      ", computeA(p, i, ctr)*

|  |
|--|
| 1/2 mark for header;<br>1/2 mark for loop;<br>1 mark for function call |
|--|

*computeA(p, i, n)*

*Assign  $p * \text{pow}(1+i, n)$  to a*

*Return a*

|   |
|---|
| 1/2 mark for header;<br>1/2 mark for return |
|---|