



FE Review : Computer (morning)

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Computers (Numerical Methods) Topics Area

- Terminology (e.g., memory types, CPU, baud rates, Internet)
 - Ignore except Numbers 😊
- Spreadsheets (e.g., addresses, interpretation, “what if”, copying formulas)
 - Ace!
- Structured Programming (e.g., assignment statements, loops and branches, function calls)
- Covers approximately 7% (~8-9 questions) of the morning session test content

PNS

- Positional Number System
 - Radix or Base (r)
 - Weight ($weight$)
 - Value ($value$)

$$value \cdot r^{weight}$$

Radix or Base

- The radix or base in most non-redundant number systems (i.e., the ones you use) have numbers from:
 - $0, 1, 2, \dots, (r-1)$
- Here they are for popular radices:
 - $r=8 \rightarrow 0, 1, 2, 3, \dots, 7$ (octal)
 - $r=10 \rightarrow 0, 1, 2, 3, \dots, 9$ (decimal)
 - $r=16 \rightarrow 0, 1, 2, 3, \dots, 15$ (hexadecimal)
 - $r=2 \rightarrow 0, 1$ (binary)

Binary Number

- Binary number : 0101110 is what in base 10?
 - A: 32
 - B: 46
 - C: 48
 - D: 56

Binary Number

- $2^5 + 2^3 + 2^2 + 2^1 = 32 + 8 + 4 + 2 = 46$

ANSWER: B

Base 10

- Base 10 number 135 is equivalent to what in binary?
 - A: 0 1100 0011
 - B: 0 1000 0111
 - C: 0 1000 1010
 - D: 0 1000 0011

Tricky?

- Multiple ways to handle...easy to use answers and go from there using what you know.
- However, hint is use highest power of 2 you know to get close:
 - Our case: $128 = 2^7$
- Looks like B, C, and D have 128 in it , but A has 128 and $64 = 192$ which is not what we need
- What's left: $135 - 128 = 7$
- Answer is clearly: B

Different bases

- As, Lewis Carroll used in his famous books, we can use different bases
- Base 5 number 213144_5 converts to what binary number:
 - A: 0 0111 0110 1101
 - B: 1 0011 0111 1100
 - C: 0 1101 1001 0101
 - D: 1 1100 1000 0011

Two things you can do!

- First, use what you know to convert number to decimal:

$$2 \cdot 5^5 + 1 \cdot 5^4 + 3 \cdot 5^3 + 1 \cdot 5^2 + 4 \cdot 5^1 + 4 \cdot 5^0$$
$$6250 + 625 + 375 + 25 + 20 + 4 = 7299$$

Hexadecimal

- Base 16 : same as before except radix = 16
 - 0 – 9 : as normal
 - A: 10
 - B: 11
 - C: 12
 - D: 13
 - E: 14
 - F: 15
- Easy : Group binary numbers into groups of 4 →
 $2^4 = 16$

Base 16

- Base 5 number 213144_5 converts to what binary number:

A: 0 0111 0110 1101 = 176D = 5997

B: 1 0011 0111 1100 = 137C = 4988

C: 0 1101 1001 0101 = 0D95 = 3477

D: 1 1100 1000 0011 = 1C83 = 7299

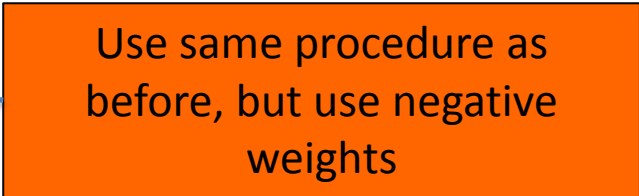
ANSWER : D

Fractions

- Some tests include fractions in binary.
- Remember the radix point or . Indicates where the weight starts at 0.
- Counting to the right of the radix point decrements from 0 \rightarrow -1, -2, -3

3 2 1 0 . -1 -2 -3 -4

- 0111.1111



Use same procedure as before, but use negative weights

Binary Number

- Binary Number 110.011_2 . What is it?

A: 6.375

B: 6.3

C: 6.875

D: 6.03

Binary Number

- Binary Number 110.011_2 . What is it?

$$1 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0 + 0 \cdot 2^{-1} + 1 \cdot 2^{-2} + 1 \cdot 2^{-3}$$
$$4 + 2 + .25 + 0.125 = 6.375$$

Answer: A

Negative Numbers

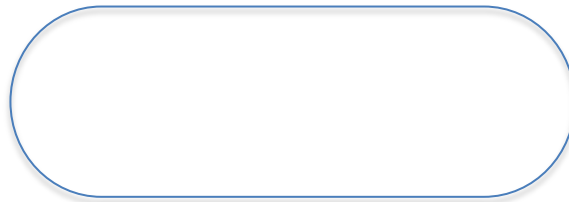
- Most negative numbers are two's complement
 - Two steps:
 - #1 : invert all
 - #2 : add 1 or unit in the last place (ulp) to step #1

Well-structured programming

- Simple sequencing
- Decision Making
- Repetition or looping

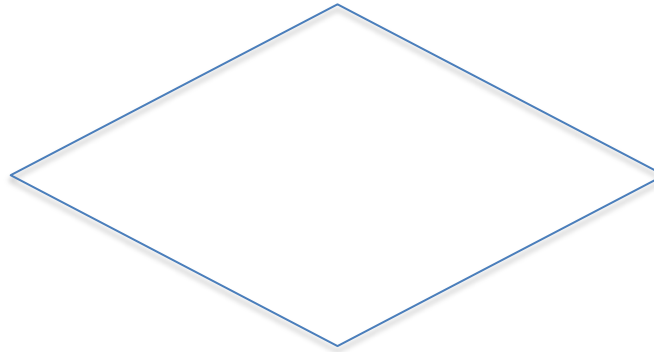
Flowcharting

- Start or Stop



Decision

- If this is TRUE do this ELSE do FALSE assertion



Input/Output

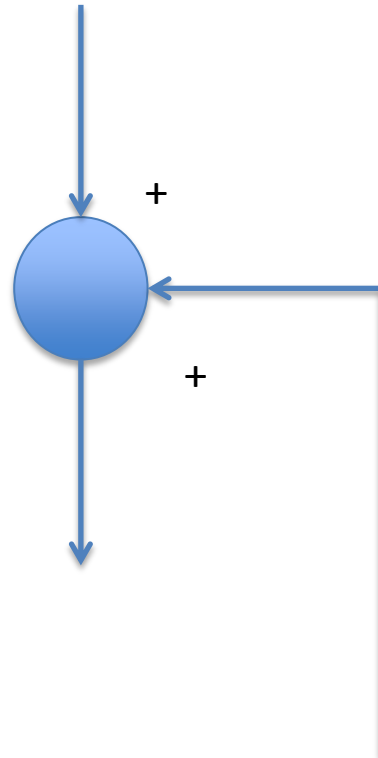
- Usually output to user some notification or compute some data



Connector

- Sometimes, but not often, a connector is shown to represent addition of processes

Sometimes + or – is shown to show polarity of connection. In this case both arrows add



Arrows show direction of flow

Programming

- Programming are sequences of steps. They can usually be stated in two common ways on the FE/EIT test:
 - Flowchart
 - Pseudocode – listing of code in somewhat easy to understand English statements
- From time to time, a question arises where a flowchart is asked for a given pseudocode and vice-versa.

Flowchart

- Draw flowchart for following code:

INPUT P, I

N = 0

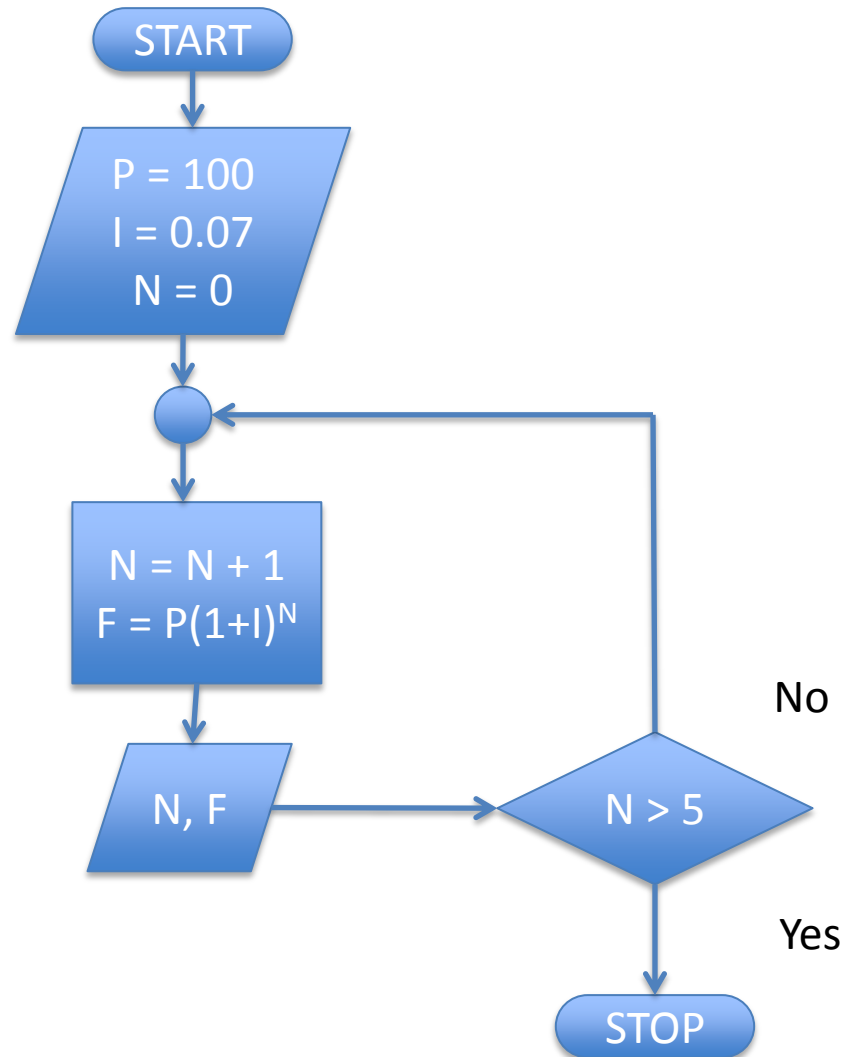
COMPUTE N = N + 1

$F = P * (1 + I)^N$

OUTPUT N, F

IF N > 5 THEN END

Flowchart for Pseudo-code



Programming

- For the following programming segment, the value of S will be equal to:

```
INPUT N
S = 0; P = 1
For I = 1 to N
    P = P * I
    S = S + 1/P
Next I
```

A: $1 + 1/1! + 1/2! + 1/3! + \dots + 1/N!$

B: $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{N}$

C: $1 + 1/2! + 1/3! + \dots + 1/N!$

D: $S = 1/(1-N)$

Document Cases

$$\underline{l = 1}$$

- $P = 1 * 1$
- $S = 0 + 1/1$

$$\underline{l = 3}$$

- $P = 1 * 2 * 3 = 6$
- $S = 1 + 1/2 + 1/6$

$$\underline{l = 2}$$

- $P = 1 * 2$
- $S = 1 + 1/2$

$$\underline{l = 4}$$

- $P = 1 * 2 * 3 * 4 = 24$
- $S = 1 + 1/2 + 1/6 + 1/24$

Answer : P is clearly the factorial and the answer is A

Another Programming Problem

- The flowchart for a computer program contains the following program. What is the result of Z?:

X = -1

Y = -2

Z = X * Y

If Z < 0 then Z = Z + 1

RETURN

A: -1

B: 0

C: 2

D: 3

Programming Cases

- $X = -1$
- $Y = -2$
- $Z = -1 * -2 = +2$
- If $Z < 0 \rightarrow \text{FALSE}$

ANSWER : C

Programming

How many times will the line START execute in the following program segment

I = 2

J = 1

START :

 J = J + 1

 I = J ^ 2

 If J < 100 then GOTO START

 ELSE GOTO FINISH

FINISH:

 PRINT J

A: 3

B: 4

C: 5

D: 6

Programming Cases

Loop	J	I
0 (initial)	1	2
1	3	9
2	12	144
3	158	24964
4		

After loop 3, $J > 100$, so the program continues and prints → ANSWER: A

Spreadsheets

- Spreadsheets were invented back in early 70s and gave PCs their killer app to be popular
- Spreadsheets will probably be on FE test
- They are easy if you remember basic ideas:
 - Data is stored in cell that is composed of letter and number : e.g., A3
 - Cells that are constant are delimited with a \$
 - \$A3 means that if this cell is copied or referenced the letter stays constant
 - A\$3 means that if this cell is copied or referenced the number stays constant
 - \$A\$3 means that no matter where the cell is copied or referenced, it always stays constant.

Spreadsheet Problem

- In a spreadsheet, the number in cell A3 is set to 5. Then, A4 is set to $A3 + \$A\3 , where \$ indicates absolute cell reference. This formula is copied into cells A5 and A6. The numbers shown in cell A6 is most nearly:
 - A: 10
 - B: 20
 - C: 25
 - D: 35

Spreadsheet Problem

	A
3	5
4	10
5	
6	

$A3 + \$A\3

Answer : B

	A
3	5
4	10
5	15
6	20

$A3 + \$A\3

$A4 + \$A\3

$A5 + \$A\3

Spreadsheet Problem

- In the following portion of a spreadsheet, the value of D1 is set to $(A1 + B1 + C1)/3$. This formula is copied into a range of cells D2:D3. The value of D4 is set to $\text{sum}(D1:D3)/4$. What is the number of D4?
 - A: 8
 - B: 3.75
 - C: 15
 - D: 30

	A	B	C	D
1	1	2	3	
2	4	5	6	
3	7	8	9	

Spreadsheet Problem

- In the following portion of a spreadsheet, the value of D1 is set to $(A1 + B1 + C1)/3$. This formula is copied into a range of cells D2:D3. The value of D4 is set to $\text{sum}(D1:D3)/4$. What is the number of D4?
 - A: 8
 - B: 3.75
 - C: 15
 - D: 30

	A	B	C	D
1	1	2	3	2
2	4	5	6	5
3	7	8	9	8
				3.75

← 15/4

Tough Problem

	A	B	C	D
1	2	\$A1		
2	4	B\$1		
3	0	A2+B2		
4	-5	A\$2+B2		??

A partial spreadsheet is given. The contents of column B are copied and pasted into column C and D. What number will be the result in cell D4?

- A: 8
- B: 16
- C: 0
- D: 4

Tough Problem

	A	B	C	D
1	2	$\$A1$	$\$A1$	$\$A1$
2	4	$B\$1$	$C\$1$	$D\$1$
3	0	$A2+B2$	$B2+C2$	$C2+D2$
4	-5	$A\$2+B2$	$B\$2+C2$	$C\$2+D2$

Tough Problem

	A	B	C	D
1	2	2	2	2
2	4	2	2	2
3	0	6	4	4
4	-5	6	4	4

ANSWER: D (even publisher got it wrong!)