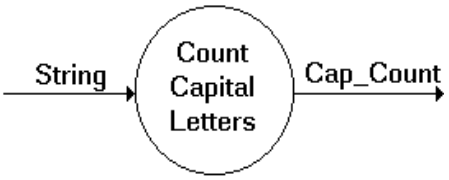
ECED 3403 - Knowledge Survey

5 May 2020

1. How can we tell if a binary number represents an odd number?

The least-significant bit (the rightmost bit, typically referenced as bit 0) is set.

2. Write a set of structured-English instructions for the following process and the supplied data dictionary entry:




```
String = {ASCII character} + NUL
Cap_Count = * Number of capital letters in String *
```

GET STRING
I = 0
CAP_COUNT = 0
WHILE STRING[I] <> NUL
    IF STRING[I] IS CAPITAL LETTER THEN
        CAP_COUNT = CAP_COUNT + 1
    END IF
    I = I + 1
END WHILE
PUT STRING

3. At a minimum, what should be stored when an interrupt occurs?

Sufficient state information to allow the interrupted entity to resume activity. This is usually the program counter and the program status word.

4. How can a number be multiplied by 16 on a machine without a multiplication instruction and without using addition?

Shift left four times.

5. What is a memory-mapped device?

Devices are associated with registers, such as control, status, and data. In a memory-mapped device, these registers are directly accessible by the CPU since they are treated as memory locations.

6. What does the value of the program-counter indicate?

The program counter indicates the address of the next instruction to execute.

7. What is stored in an interrupt vector?

At a minimum, the address of the interrupt service routine (ISR).

8. What is a symbol table?

A symbol table is a structure used in compilers and assemblers to hold information such as the name of the symbol, its type, and its memory location.

9. Under what conditions is the carry-bit set?

The carry bit is set when two numbers are added and the result exceeds the number of bits in the structure. For example, adding two 16-bit values giving a 17-bit result (0xFFFF + 0x0001 -> 0x0000 and the carry bit is set).

10. When `funcX()` is called, a segmentation fault occurs. What caused it?

```
int *funcX(int value)
{
int *ptr;
*ptr = value;
return ptr;
}
```

The variable `ptr` *is a pointer (*`*ptr`*) to an integer. It needs to be initialized with an address before it is used. In this case, it has not been initialized (i.e., it points to who-knows-where). The CPU attempts to store the rvalue (*`value`*) into the address specified in* `*ptr`*, (dereferenced as a lvalue). Since* `ptr` *has not been initialized, a segmentation fault will occur if the address is invalid.*

11. In the following C/C++ statement, what is the value of DD?

```
enum XX {AA, BB, CC, DD, EE, FF};
```

DD has a value of 3.

12. In a function call, where are the arguments stored?

Typically, on the stack, but some systems pass some or all the arguments by register.

13. What is a Princeton architecture?

A computer system with a Princeton or von Neumann architecture has both code and data stored in the same memory.

14. What is one of the limitations of signed-magnitude arithmetic?

A signed magnitude has a sign bit (the most-significant bit) and its magnitude in the remaining bits. A negative number is simply the magnitude of the number with the sign bit set. For example, the negative of 0000.0001 (+1) is 1000.0001 (-1). This leads to several problems, it can make arithmetic more complex and resulting in two zeroes: 0000.0000 (+0) and 1000.0000 (-0)!

15. What is the output of the following program? (`printf()` is equivalent to `cout <<`.)

```
void func(int x)
{
if (x < 5)
  func(x+1);
printf("%d ", x);
}
main()
{
func(0);
printf("\n");
}
```

This is an example of recursion, in which a block of code calls itself. In this example, it calls itself with an argument 'x' which is initially zero and, if x is less than 5, it calls itself with x+1. Eventually, x becomes 5, causing the condition to fail, resulting in the printing of 'x', which is 5 at this point. The function returns to where it was called, which is the end of the if statement and the value of 'x' at that point (4, 3, 2, 1, and 0). The function displays, on a single line:

```
5 4 3 2 1 0
```

When control returns to main(), the final printf() outputs an end-of-line.

16. Rewrite the following code fragment using a single if-else:

```
if (a > b)
  funcA();
else
if (a == b)
  funcB();
else
  funcA();
```

First, we need to observe that funcB() is called only when a equals b. There are two possible rewrites:

```
if (a <> b)
  funcA();
else
  funcB();
```

or

```
if (a == b)
  funcB();
else
  funcA();
```

This is an example of de Morgan's rules.

17. What is a register file?

A register file is the part of the CPU that holds the CPU's registers.

18. What does an interrupt indicate?

A device is signalling that it has undergone a status change.

19. In a Data Dictionary, what are the possible meanings of:

```
address = street address + city + (province) + (postal code)
```

An `address` *can be one of:*

```
street address + city
street address + city + province
street address + city + postal code
street address + city + province + postal code
```

20. Where is a return address stored?

Typically, on the stack. In some machines it can be in a separate register, the Link Register.

21. What is used to terminate a string a C?

A NUL character (0x00 or '\0'). See question 2.

22. What does a dataflow diagram represent?

A dataflow diagram represents the changes to data as it passes through the dataflow diagram's procedures. It is more than simply the flow of data.

23. In a machine that only supports addition, how is subtraction performed?

In A-B, the two's complement of the subtrahend (B) is obtained by taking the one's complement of B and adding 1, negating its previous value. The minuend (A) and the complemented subtrahend (B) can then be added.

24. What information is carried on a machine's bus?

At a minimum, an address of a memory location (CPU to Memory), the data being written to that location or the data (or instruction) being read from that location, and a control signal indicating whether it is a read or write operation.

25. What is the heap?

The heap is an area of memory used for dynamic memory allocation at run time.