OPCode Examples:
Calculate the following parameters for this hypothetical computer system with the given features:

a) Octal Notation **(Binary - 1 bit, Octal - 3 bits, Hexa - 4 bits)**
b) IR = OPCode + Memory Address (PC - program counter)
c) IR = 12 bits
d) PC = 3 Octal Digits
e) Memory Word Size = IR

1) Number of different OPCodes?

IR = OPCode + Memory Address
12 bits = OPCode + 3 Octal Digits * 3 bits
12 bits = OPCode + 9 bits, OPCode bits = 3 bits.
2^(OPCode bits) = 2^3 = 8 different OPCodes

2) Memory size in bits?

different Memory Address * Memory Word Size = Memory size in bits
3 Octal Digits * 3 bits = 9 bits - (number of bits in memory address)
2^(Memory Address bits) = 2^9 = 512 different Memory Address
512 * 12 = 6144 memory size bits

3) Memory range?

Octal notation (000-111) -> (0-7) For e.g. Hexa notation (0000-1111) -> (0-F)
Memorize: Binary (0-1), Octal (0-7), Hexa (0-F)
PC = 3 Octal Digits = 3 of (0-7)
Memory Range = 000-777

4) Total Data range?

Data Range = OPCode Range + Memory Range
OPCode = 3 bits
OPCode Digits = OPCode bits / 3 (bits in Octal notation) = 3 bits / 3 = 1 Octal Digit
OPCode Range = 0-7
Memory Range = 000-777
Data Range = 0000-7777

Calculate the following parameters for this hypothetical computer system with the given features:

a) Binary Notation (1 bit, 0-1) Hexa Notation (4 bits)
b) IR = OPCode + Memory Address
c) 2 OPCode Digits
d) PC (Memory Address) = 3 bits
e) Memory Word Size = IR

1) Number of different OPCodes?
different OPCode = 2^(OPCode bits)
2 OPCode digits * 1 bit = 2 OPCode bits
different OPCode = 2^2 = 4 different OPCodes

2 OPCode digits * 4 bits = 8 OPCode bits
different OPCode = 2^8 = 256 different OPCodes

2) Memory size in bits?
# different Memory Address * Memory Word Size = Memory size in bits
# different Memory Address = 2^3 bits of Memory Address = 8 # different Memory Address
IR = OPCode + Memory Address
IR = 2 bits + 3 bits = 5 bits = Memory Word Size
8 * 5 bits (IR) = 40 Memory size in bits

3) Memory range?
3 bits in Memory Address / 1 (1 bit per Binary Digit) = 3 Binary Digits
Binary Digit (0-1), 3 Binary Digits - 3 of (0-1)
Memory Range: 000-111

4) Total data range?
Data Range = OPCode Range + Memory Range
OPCode Range = 2 of (0-1) = 00-11
Memory Range = 000-111
Data Range = 00-11 + 000-111 = 00000-11111

Forking Examples:

Ex 1:
Make a multiprocessing code that runs the following outputs:

```
I am the parent process
I am the child process 0
I am a grand-child process from child process 0
I am the child process 1
I am a grand-child process from child process 1
I am a grand-child process from child process 1
I am the child process 2
I am a grand-child process from child process 2
I am the child process 3
```

Use _exit(0) to terminate/halt child processes, and use wait(nullptr)/wait(NULL) to ensure correct outputs.
DO NOT USE THE FUNCTION sleep(n) such that n is an integer representing how many seconds a system is required to wait for. **THIS IS CONSIDERED CHEATING.**

Ex 2:

I am the parent process
I am the child process 0
I am the child process 1
I am a grand-child process from child process 1
I am the child process 2
I am a grand-child process from child process 2
I am a grand-child process from child process 2
I am the child process 3
I am a grand-child process from child process 3
I am a grand-child process from child process 3
I am a grand-child process from child process 3

Average Access Time Examples:

Ex 1:
L1 Memory Access Time = 50 ms
L2 Memory Access Time = 400 ms
Miss Ratio = 20% (0.2)
Hit Ratio = 1 - 20% = 0.8
Average Access Time = ?
Hit Ratio * L1 + Miss Ratio * (L1 + L2) = Avg. Access Time
(0.8 * 50ms) + 0.2 * (50ms + 400ms) = Avg. Access Time

Ex 2:
L1 Memory Access Time = 50 ms
Hit Ratio = 85%
Miss Ratio = 1 - 85% = 0.15
Average Access Time = 117.5 ms

L2 Memory Access Time = ?
Hit Ratio * L1 + Miss Ratio * (L1 + L2) = Avg. Access Time
0.85 * 50ms + 0.15 * (50ms + L2) = 117.5 ms
42.5ms + 7.5ms + 0.15(L2) = 117.5ms
50ms + 0.15(L2) = 117.5ms
0.15(L2) = 67.5
L2 = 450ms

Formula: Hit Ratio * L1 + Miss Ratio * (L1 + L2) = Avg. Access Time
Hit Ratio + Miss Ratio = 1 (100%)

Calculate the following parameters for this hypothetical computer system with the given features:

a) Hex Notation
b) IR = OPCode + Memory Address
c) IR = 24 bits
d) PC = 5 Hex Digits
e) Memory Word Size = IR

1) Number of different OPCodes?

2) Memory size in bits?

3) Memory range?

4) Total data range?