

HW 1

Question 1

What is the output of the following program? List ALL the possible output(s)

1. Parent process runs first:

```
Parent's num is 110  
end num is 109  
Child's num is 130  
end num is 129
```

2. Child process runs first

```
Child's num is 130  
end num is 129  
Parent's num is 110  
end num is 109
```

3. Parent prints first then Child

```
Parent's num is 110  
Child's num is 130  
end num is 109  
end num is 129
```

4. Child prints first then Parent

```
Child's num is 130  
Parent's num is 110  
end num is 129  
end num is 109
```

Question 2

Which of the following scheduling algorithms could result in starvation? For those algorithms that might result in starvation, describe a situation in which starvation is likely to occur? (2 points)

1. First-come, first-served (FCFS)

FCFS does not typically result in starvation because each process will eventually get its turn to execute.

2. Shortest Job First (SJF)

SJF can result in starvation if there is a continuous stream of short jobs. In this case, longer jobs may never get scheduled because there are always shorter jobs arriving.

3. Round Robin

Round Robin does not typically result in starvation because each process gets an equal share of the CPU time in a cyclic order.

4. Basic MLFQ with first 4 rules

Basic MLFQ can result in starvation if a process is demoted to a lower-priority queue and there are always higher-priority processes available to run. The lower-priority process may never get CPU time.

Job, Length, Arrival Time

J1, 85s, 0

J2, 30, 10

J3, 35, 10

J4, 20, 80

J5, 50, 85

Time slice = 10s

FIFO

J1: completion 85, turnaround 85, response 0

J2: completion 115, turnaround $115 - 10 = 105$, response 85

J3: completion 150, turnaround $150 - 10 = 140$, response 115

J4: completion 170, turnaround $170 - 80 = 90$, response 150

J5: completion 220, turnaround $220 - 85 = 135$, response 170

Average Turnaround Time: $(85 + 105 + 140 + 90 + 135) / 5 = 111$

Average Response Time: $(0 + 85 + 115 + 150 + 170) / 5 = 104$

RR

- Round 1:
 - J1 0-10, 75
- Round 2:
 - J1 10-20, 65
 - J2 20-30, 20
 - J3 30-40, 25
- Round 3:
 - J1 40-50, 65
 - J2 50-60, 10
 - J3 60-70, 15
- Round 4:
 - J1 70-80, 55
 - J2 80-90, 0, completion 90
 - J3 90-100, 5
 - J4 100-110, 10
 - J5 110-120, 40

- Round 5:
 - J1 120-130, 45
 - J3 130-135, 0, completion 135
 - J4 135-145, 0, completion 145
 - J5 145-155, 30
- Round 6:
 - J1 155-165, 35
 - J5 165-175, 20
- Round 7:
 - J1 175-185, 25
 - J5 185-195, 10
- Round 8:
 - J1 205-215, 15
 - J5 215-225, 0, completion 225
- Round 9:
 - J1 225-235, 5
- Round 10:
 - J1 235-240, 0, completion 240

J1: completion 240, turnaround $240 - 0 = 240$, response 0

J2: completion 90, turnaround $90 - 10 = 80$, response 10

J3: completion 135, turnaround $135 - 10 = 125$, response 20

J4: completion 145, turnaround $145 - 80 = 65$, response 20

J5: completion 225, turnaround $225 - 85 = 140$, response 25

Average Turnaround Time: $(240 + 80 + 125 + 65 + 140) / 5 = 130$

Average Response Time: $(0 + 10 + 20 + 20 + 25) / 5 = 15$

STCF

- J1 0-10, (remaining 75)
- J2 arrives at 10, J3 arrives at 10
- J2 10-40 (remaining 0, completion 40)
- J3 40-75 (remaining 0, completion 75)
- J1 75-80 (remaining 70)
- J4 arrives at 80
- J4 80-100 (remaining 0, completion 100)
- J5 arrives at 85
- J5 100-150 (remaining 0, completion 150)
- J1 150-225 (remaining 0, completion 225)

J1: completion 225, turnaround $225 - 0 = 225$, response 0

J2: completion 40, turnaround $40 - 10 = 30$, response 10

J3: completion 75, turnaround $75 - 10 = 65$, response 40

J4: completion 100, turnaround $100 - 80 = 20$, response 80

J5: completion 150, turnaround $150 - 85 = 65$, response 100

Average Turnaround Time: $(225 + 30 + 65 + 20 + 65) / 5 = 81$

Average Response Time: $(0 + 10 + 40 + 80 + 100) / 5 = 46$

Question 3

Process, Length, Arrival Time

P1, 16, 0

P2, 7, 2

P3, 2, 4

P4, 4, 6

P5, 22, 8

1. P1: completion 16, turnaround 16
P2: completion 23, turnaround 21
P3: completion 25, turnaround 21
P4: completion 29, turnaround 23
P5: completion 51, turnaround 43

Average turnaround = $(16 + 21 + 21 + 23 + 43) / 5 = 24.8$

2. P1: completion 16, turnaround 16
P3: completion 18, turnaround 14
P2: completion 25, turnaround 23
P4: completion 29, turnaround 23
P5: completion 51, turnaround 43

Average turnaround = $(16 + 14 + 23 + 23 + 43) / 5 = 23.8$

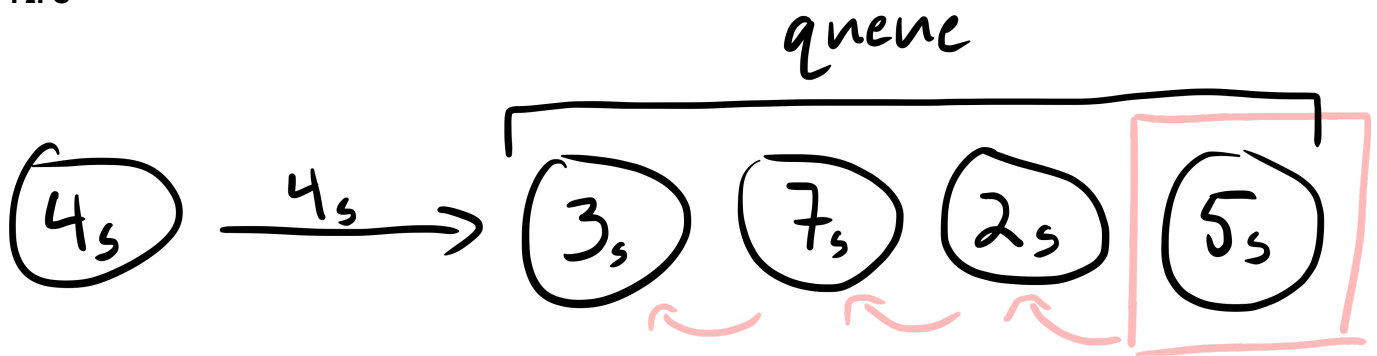
3. P1: completion 29, turnaround 29
P2: completion 9, turnaround 7
P3: completion 11, turnaround 7
P4: completion 15, turnaround 9
P5: completion 51, turnaround 43

Average turnaround = $(29 + 7 + 7 + 9 + 43) / 5 = 19$

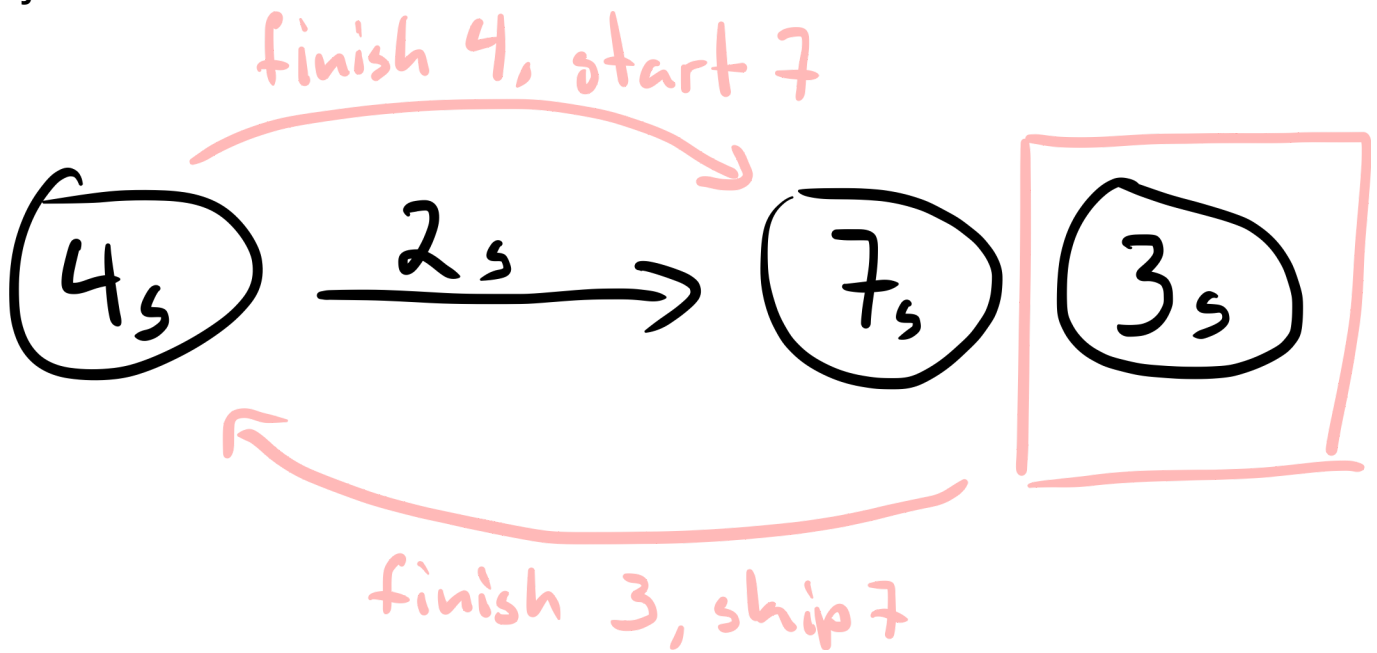
4. P1: completion 44, turnaround 44
P2: completion 28, turnaround 26
P3: completion 12, turnaround 8
P4: completion 16, turnaround 10
P5: completion 51, turnaround 43

Average turnaround = $(44 + 26 + 8 + 10 + 43) / 5 = 26.2$

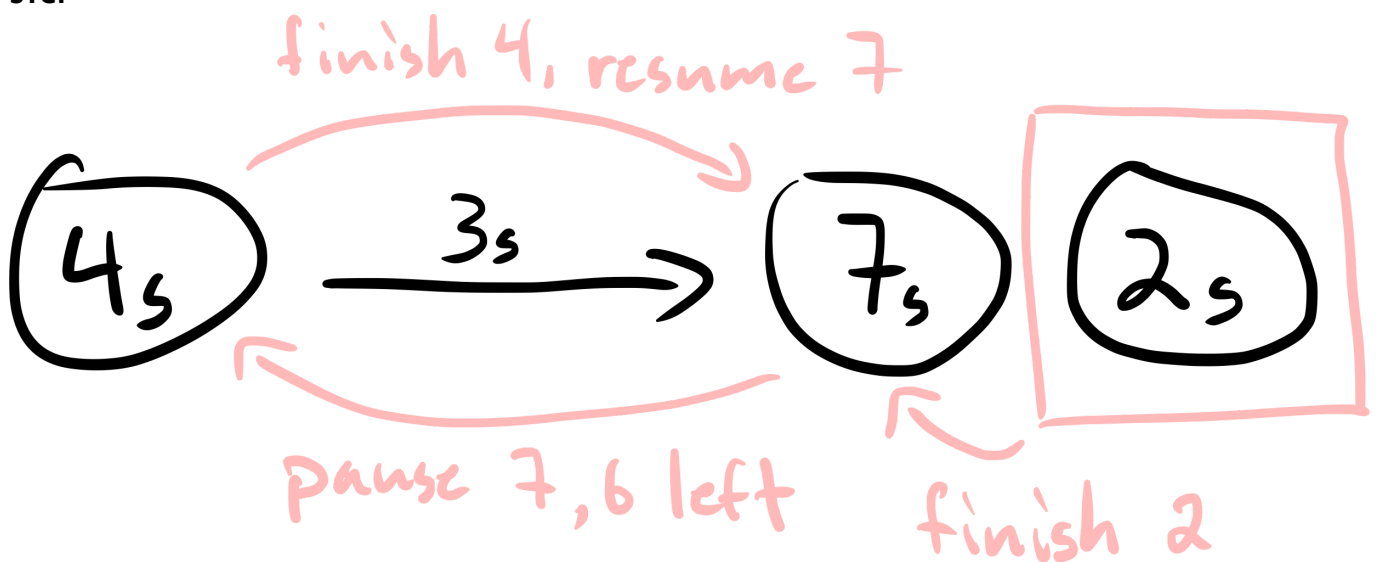
FIFO



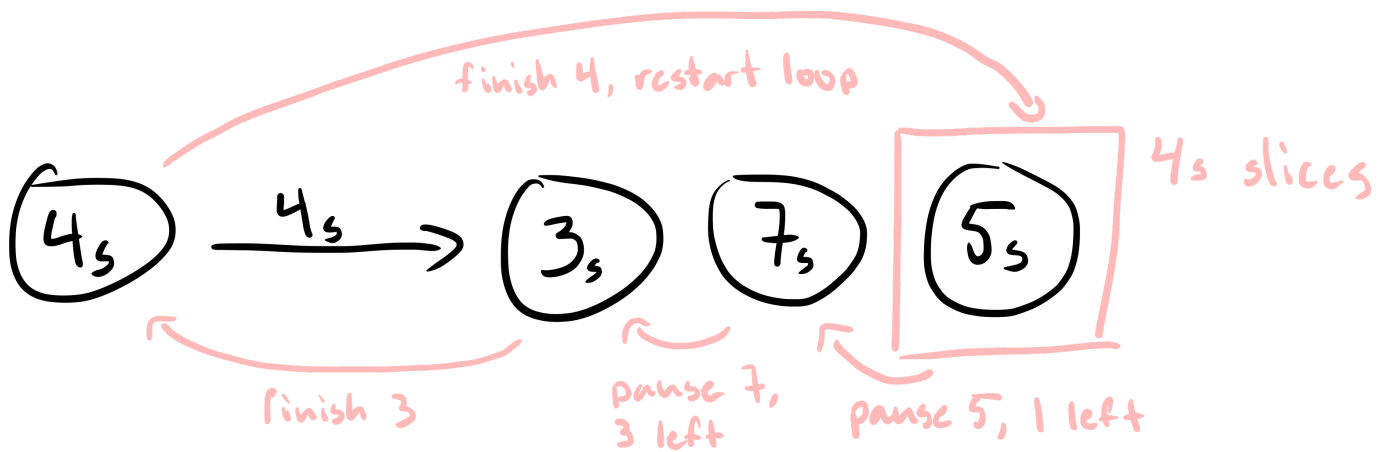
SJF



STCF



RR



Question 4

```

int* add(const int* a, const int* b) {
    if (a == NULL || b == NULL)
        return NULL;
    int *ret = malloc(sizeof(int));
    if (ret == NULL)
        return NULL;
    *ret = *a + *b;
    return ret;
}

int main(int argc, char** argv) {
    int a = 3;
    int b = 4;
    int *ret = add(&a, &b);
    if (ret == NULL)
        printf("Error\n");
    else {
        printf("3+4=%d\n", *ret);
        free(ret); // Free the allocated memory
    }
    return 0;
}

```