CS 342 - 03
Operating Systems
Homework 3

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1)

	Allocation	Need	Remaining = 15-A-B
P1	A	10-A	
P2	B	12-B	

To be safe => $B \leq 5$ or $A \leq 3$

$10-A \leq 15-A-B$ → $B \leq 5$

$12-B \leq 15-A-B$ → $A \leq 3$

Total = 13.4+6.6 = 78 safe state

2) After alloc, remaining resource => (3,3,0)

Finish P4 ⟶ new = (4,3,1)

Finish P1 ⟶ new = (5,3,1)

P2, P3, P5 requires more than available, so none of them will finish.
This results deadlock.

4)

a) Virtual addr = 36 bits = 2^{36} bytes
Page size = 16 KB = 2^{14} bytes
} $2^{36}/2^{14} = 2^{22}$ pages

$2^{22} \cdot 2^3 = 2^{25} = 32\,MB$

b) 2^{11} entries in 2nd level → $2^{11} \cdot 2^{14} = 2^{15} = 32\,MB$

$\frac{128}{32} + \frac{64}{32} + \frac{32}{32} + 1$ top level = 8 tables

8.16 KB = 128 KB

c) $\frac{2^{32}}{2^{14}} = 2^{18}$ entries $2^{18} \cdot 2^3 = 2^{21} = 2\,MB$

5)

a) Block size = 4 KB

Pointer size = 8 byte

12 direct = 12.4 = 48 KB

1 single indirect = 512.4 = 2048 KB = 2 MB

1 double " = 512^2.4 = 1 GB

1 triple " = 512^3.4 = 512 GB

max size = 512 GB + 1 GB + 2 MB + 48 KB

b) 30 KB => $\frac{30.2^{10}}{2^{12}} = 8 < 12$ inode is enough

256 KB => $\frac{2^{18}}{2^{12}} = 64 > 12$ not enough => $\frac{52}{512} = 1$ block

15 MB => $\frac{15.2^{20}}{2^{12}} = 3048 > 12$ not enough => $\frac{3036}{512} = 6$ blocks

512 MB => $\frac{2^{29}}{2^{12}} = 2^{17} > 12$ not enough => $\frac{2^{17}-12}{2^9} = 2^8 = 256$ blocks

32 GB => $\frac{2^{35}}{2^{12}} = 2^{23} > 12$ not enough => $\frac{2^{23}-12}{2^9} = 2^{14}$ blocks

c) 16 KB = $\frac{2^{14}}{12.2^{12}} = 0$ => mod = 4 => total of 4 read

64 MB = $\frac{2^{26}}{2^{12}} = 2^{14}$ => pointed by double indirect => 6 read is needed

7) 4KB → unit size

9 disks → 8 blocks 1 parity block

RPM: 1500

Avg : 4ms

max rate: 100MB/s

a) $T_{IO} = T_{seek} + T_{rotation} + T_{transfer}$

$\overbrace{\quad}^{6.04ms}$ $\overbrace{\quad}^{2ms}$ $\overbrace{\quad}^{0.04ms}$

$R = 0.66 MB/s$

$N \times R = 5.94 MB/s$ => random read

N: 9

b) $T_{transfer} = 1000 ms$

$T_{rotation} = 2ms$

$T_{IO} = 1006 ms$ $S = 99.4 MB/s$

$(N-1) \times S = 795.2 MB/s$

8) $$MTTDL = \frac{MTTF^2}{N \times (N-1) \times MTTR} = \frac{50000^2}{9 \times 8 \times 48} = 723380 \text{ hours} \approx 82.5 \text{ years}$$