Operativsystemer TDT4186 2011
Øving 3
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Vi velger å operere ut fra antagelsen om at CPU bruken i prosent og antall ferdige prosesser er de viktigste faktorene for effektiviteten av algoritmen, og vil da hovedsaklig fokusere på disse.
Fra beskrivelsen av parameterne er det også klart at størrelsen på minnet er irrelevant da programmer alltid tar 1-25% av dette uansett størrelsen på minnet.
Videre vil kun treg skaping av nye prosessor i minnekøen ha noen effekt på effektiviteten.

For å effektivisere prosessen har vi forandret tiden en prosess bruker fra:
```
cpuTimeNeeded = 100 + (long)(Math.random()*9900);
```
til
```
cpuTimeNeeded = 100 + (long)(Math.random()*990);
```

Vi kjører simulerer derfor systemet konsekvent i 100 sekunder, med 500 i minne og 10ms mellom nye prosesser. Derfor blir eneste variablene vi opererer med maks CPU tid og I/O tid.

All statistikk fra kjøringen limes inn nederst, med 2 kjøringer pr set med attributer.

	CPU tid	I/O tid	Effektivitet kjøring #1	Effektivitet kjøring #2
#1	10	10	99.904% 166p	99.963% 161p
#2	100	100	46.406002% 78p	52.323997% 87p
#3	10	100	62.897003% 103p	47.284% 89p
#4	100	10	99.82% 174p	99.875% 167p
#5	500	10	99.681% 159p	99.693% 158p
#6	10	500	11.076% 17p	9.161% 14p

Som vi ser her har CPU tiden svært liten effekt på effektiviteten, med en ørliten tendens mot at kortere er bedre. I/O tid derimot har en EKSTREM effekt på resultatet.

```
#1.1
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 10
Average I/O operation time (ms): 10
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
<queue threw error>

Simulation statistics:

Number of completed processes:                          166
Number of created processes:                            3965
Number of forced Process switches:                      8554
IO Operations:                                          2737
Throughput: (finished/sec)                              1.66

Active CPUtime:                                         99904
Inactive CPUtime:                                       96
Active CPU percentage:                                  99.904
Inactive CPU percentage:                                0.09600067

Largest occuring memory queue length:                   3795
Average memory queue length:                            1892.6691
Largest occuring CPU queue length:                      4
Largest occuring IO queue length:                       3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:      45739 ms
Average # of times a process has been placed in CPU queue:    51
Average time spent waiting for CPU per process:         2406 ms
Average # of times a process has been placed in IO queue:     8
Average time spent waiting for IO:                      835 ms

Time per completed process:                             602.40967 ms
Time per completed process waiting for memory:          45739.69 ms
Time in CPU per completed process:                      601.8313 ms
Time per completed process waiting for CPU:             2406.2168 ms
Time per completed process waiting for IO:              835.8735 ms
Time in Io per completed process:                       173.96988 ms
```

#1.2
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 10
Average I/O operation time (ms): 10
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
<u>\<Queue threw error\></u>

Simulation statistics:

Number of completed processes:	161
Number of created processes:	3960
Number of forced Process switches:	8655
IO Operations:	2488
Throughput: (finished/sec)	1.61

Active CPUtime:	99963
Inactive CPUtime:	37
Active CPU percentage:	99.963
Inactive CPU percentage:	0.037002563

Largest occuring memory queue length:	3795
Average memory queue length:	1902.0659
Largest occuring CPU queue length:	4
Largest occuring IO queue length:	3

Average # of times a process has been placed in memory queue:	1
Average time spent waiting for memory per process:	45102 ms
Average # of times a process has been placed in CPU queue:	53
Average time spent waiting for CPU per process:	2690 ms
Average # of times a process has been placed in IO queue:	6
Average time spent waiting for IO:	1047 ms

Time per completed process:	621.11804 ms
Time per completed process waiting for memory:	45102.043 ms
Time in CPU per completed process:	620.8882 ms
Time per completed process waiting for CPU:	2690.4722 ms
Time per completed process waiting for IO:	1047.1802 ms
Time in Io per completed process:	160.36646 ms

```
#2.1
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 100
Average I/O operation time (ms): 100
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                              78
Number of created processes:                                3941
Number of forced Process switches:                          152
IO Operations:                                              1287
Throughput: (finished/sec)                                  0.78

Active CPUtime:                                             46406
Inactive CPUtime:                                           53594
Active CPU percentage:                                      46.406002
Inactive CPU percentage:                                    53.593998

Largest occuring memory queue length:                       3859
Average memory queue length:                                1921.976
Largest occuring CPU queue length:                          4
Largest occuring IO queue length:                           3

Average # of times a process has been placed in memory queue: 1
Average time spent waiting for memory per process:           36639 ms
Average # of times a process has been placed in CPU queue:   2
Average time spent waiting for CPU per process:              929 ms
Average # of times a process has been placed in IO queue:    30
Average time spent waiting for IO:                           1403 ms

Time per completed process:                                 1282.0513 ms
Time per completed process waiting for memory:              36639.32 ms
Time in CPU per completed process:                          594.9487 ms
Time per completed process waiting for CPU:                 929.79486 ms
Time per completed process waiting for IO:                  1403.9744 ms
Time in Io per completed process:                           1632.9487 ms
```

```
#2.2
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 100
Average I/O operation time (ms): 100
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                              87
Number of created processes:                               3935
Number of forced Process switches:                         190
IO Operations:                                             1278
Throughput: (finished/sec)                                 0.87

Active CPUtime:                                            52324
Inactive CPUtime:                                          47676
Active CPU percentage:                                     52.323997
Inactive CPU percentage:                                   47.676003

Largest occuring memory queue length:                      3844
Average memory queue length:                               1918.6294
Largest occuring CPU queue length:                         4
Largest occuring IO queue length:                          3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:             46041 ms
Average # of times a process has been placed in CPU queue:     3
Average time spent waiting for CPU per process:                907 ms
Average # of times a process has been placed in IO queue:      26
Average time spent waiting for IO:                             1287 ms

Time per completed process:                               1149.4253 ms
Time per completed process waiting for memory:            46041.473 ms
Time in CPU per completed process:                        601.4253 ms
Time per completed process waiting for CPU:               907.069 ms
Time per completed process waiting for IO:                1287.7012 ms
Time in Io per completed process:                         1450.5287 ms
```

```
#3.1
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 10
Average I/O operation time (ms): 100
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                              103
Number of created processes:                               3952
Number of forced Process switches:                         5574
IO Operations:                                             1273
Throughput: (finished/sec)                                 1.03

Active CPUtime:                                             62897
Inactive CPUtime:                                          37103
Active CPU percentage:                                     62.897003
Inactive CPU percentage:                                   37.102997

Largest occuring memory queue length:                      3845
Average memory queue length:                               1937.461
Largest occuring CPU queue length:                         4
Largest occuring IO queue length:                          3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:            47787 ms
Average # of times a process has been placed in CPU queue:    53
Average time spent waiting for CPU per process:               1029 ms
Average # of times a process has been placed in IO queue:     21
Average time spent waiting for IO:                            962 ms

Time per completed process:                                970.8738 ms
Time per completed process waiting for memory:             47787.633 ms
Time in CPU per completed process:                         610.6505 ms
Time per completed process waiting for CPU:                1029.0486 ms
Time per completed process waiting for IO:                 962.9709 ms
Time in Io per completed process:                          1194.7767 ms
```

```
#3.2
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 10
Average I/O operation time (ms): 100
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                              89
Number of created processes:                                4002
Number of forced Process switches:                          4014
IO Operations:                                              1310
Throughput: (finished/sec)                                  0.89

Active CPUtime:                                             47284
Inactive CPUtime:                                          52716
Active CPU percentage:                                      47.284
Inactive CPU percentage:                                    52.716

Largest occuring memory queue length:                       3909
Average memory queue length:                                1943.3044
Largest occuring CPU queue length:                          4
Largest occuring IO queue length:                           3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:          42797 ms
Average # of times a process has been placed in CPU queue:  44
Average time spent waiting for CPU per process:             602 ms
Average # of times a process has been placed in IO queue:   27
Average time spent waiting for IO:                          1129 ms

Time per completed process:                                1123.5955 ms
Time per completed process waiting for memory:             42797.414 ms
Time in CPU per completed process:                         531.2809 ms
Time per completed process waiting for CPU:                602.0 ms
Time per completed process waiting for IO:                 1129.0562 ms
Time in Io per completed process:                          1475.764 ms
```

```
#4.1
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 100
Average I/O operation time (ms): 10
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                            174
Number of created processes:                             3925
Number of forced Process switches:                        333
IO Operations:                                           2666
Throughput: (finished/sec)                               1.74

Active CPUtime:                                          99820
Inactive CPUtime:                                         180
Active CPU percentage:                                   99.82
Inactive CPU percentage:                                 0.1800003

Largest occuring memory queue length:                    3747
Average memory queue length:                             1869.3126
Largest occuring CPU queue length:                       4
Largest occuring IO queue length:                        3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:        44869 ms
Average # of times a process has been placed in CPU queue:    2
Average time spent waiting for CPU per process:           5459 ms
Average # of times a process has been placed in IO queue:     9
Average time spent waiting for IO:                        4290 ms

Time per completed process:                              574.71265 ms
Time per completed process waiting for memory:           44869.996 ms
Time in CPU per completed process:                       573.67816 ms
Time per completed process waiting for CPU:              5459.908 ms
Time per completed process waiting for IO:              4290.5117 ms
Time in Io per completed process:                        161.36208 ms
```

```
#4.2
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 100
Average I/O operation time (ms): 10
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                              167
Number of created processes:                               3854
Number of forced Process switches:                         374
IO Operations:                                             2263
Throughput: (finished/sec)                                 1.67

Active CPUtime:                                            99875
Inactive CPUtime:                                          125
Active CPU percentage:                                     99.875
Inactive CPU percentage:                                   0.125

Largest occuring memory queue length:                     3683
Average memory queue length:                              1828.863
Largest occuring CPU queue length:                        4
Largest occuring IO queue length:                         3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:        47056 ms
Average # of times a process has been placed in CPU queue:  3
Average time spent waiting for CPU per process:           5248 ms
Average # of times a process has been placed in IO queue:  7
Average time spent waiting for IO:                        4032 ms

Time per completed process:                               598.80237 ms
Time per completed process waiting for memory:            47056.246 ms
Time in CPU per completed process:                        598.0539 ms
Time per completed process waiting for CPU:               5248.084 ms
Time per completed process waiting for IO:                4032.1616 ms
Time in Io per completed process:                         142.09581 ms
```

```
#5.1
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 500
Average I/O operation time (ms): 10
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
<Queue threw exception>

Simulation statistics:

Number of completed processes:                              159
Number of created processes:                               3994
Number of forced Process switches:                         0
IO Operations:                                             2598
Throughput: (finished/sec)                                 1.59

Active CPUtime:                                            99681
Inactive CPUtime:                                         319
Active CPU percentage:                                    99.681
Inactive CPU percentage:                                  0.31900024

Largest occuring memory queue length:                      3831
Average memory queue length:                              1922.0063
Largest occuring CPU queue length:                         3
Largest occuring IO queue length:                          3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:         45830 ms
Average # of times a process has been placed in CPU queue:   1
Average time spent waiting for CPU per process:            6462 ms
Average # of times a process has been placed in IO queue:    12
Average time spent waiting for IO:                         5399 ms

Time per completed process:                               628.93085 ms
Time per completed process waiting for memory:            45830.69 ms
Time in CPU per completed process:                        626.9245 ms
Time per completed process waiting for CPU:               6462.371 ms
Time per completed process waiting for IO:                5399.258 ms
Time in Io per completed process:                         176.5912 ms
```

```
#5.2
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 500
Average I/O operation time (ms): 10
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                          158
Number of created processes:                            3907
Number of forced Process switches:                      0
IO Operations:                                          2314
Throughput: (finished/sec)                              1.58

Active CPUtime:                                         99693
Inactive CPUtime:                                       307
Active CPU percentage:                                 99.693
Inactive CPU percentage:                               0.3069992

Largest occuring memory queue length:                  3745
Average memory queue length:                           1899.9069
Largest occuring CPU queue length:                     3
Largest occuring IO queue length:                      3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:         47905 ms
Average # of times a process has been placed in CPU queue:     1
Average time spent waiting for CPU per process:            6650 ms
Average # of times a process has been placed in IO queue:     10
Average time spent waiting for IO:                         5515 ms

Time per completed process:                            632.9114 ms
Time per completed process waiting for memory:         47905.97 ms
Time in CPU per completed process:                     630.9684 ms
Time per completed process waiting for CPU:            6650.7153 ms
Time per completed process waiting for IO:             5515.4365 ms
Time in Io per completed process:                      151.70886 ms
```

```
#6.1
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 10
Average I/O operation time (ms): 500
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                          17
Number of created processes:                            3957
Number of forced Process switches:                      966
IO Operations:                                          269
Throughput: (finished/sec)                              0.17

Active CPUtime:                                         11076
Inactive CPUtime:                                       88924
Active CPU percentage:                                  11.076
Inactive CPU percentage:                                88.923996

Largest occuring memory queue length:                   3936
Average memory queue length:                            1990.844
Largest occuring CPU queue length:                      4
Largest occuring IO queue length:                       3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:      24583 ms
Average # of times a process has been placed in CPU queue:     47
Average time spent waiting for CPU per process:         148 ms
Average # of times a process has been placed in IO queue:      25
Average time spent waiting for IO:                      5874 ms

Time per completed process:                             5882.353 ms
Time per completed process waiting for memory:          24583.059 ms
Time in CPU per completed process:                      651.5294 ms
Time per completed process waiting for CPU:             148.88235 ms
Time per completed process waiting for IO:              5874.647 ms
Time in Io per completed process:                       7796.647 ms
```

```
#5.2
Please input system parameters:
Memory size (KB): 500
Maximum uninterrupted cpu time for a process (ms): 10
Average I/O operation time (ms): 500
Simulation length (ms): 100000
Average time between process arrivals (ms): 25
Simulating.....done.

Simulation statistics:

Number of completed processes:                          14
Number of created processes:                            3952
Number of forced Process switches:                      807
IO Operations:                                          276
Throughput: (finished/sec)                              0.14

Active CPUtime:                                         9161
Inactive CPUtime:                                       90839
Active CPU percentage:                                  9.161
Inactive CPU percentage:                                90.839

Largest occuring memory queue length:                  3934
Average memory queue length:                            1953.764
Largest occuring CPU queue length:                      3
Largest occuring IO queue length:                       3

Average # of times a process has been placed in memory queue:  1
Average time spent waiting for memory per process:      32337 ms
Average # of times a process has been placed in CPU queue:     45
Average time spent waiting for CPU per process:         191 ms
Average # of times a process has been placed in IO queue:      30
Average time spent waiting for IO:                      7129 ms

Time per completed process:                             7142.857 ms
Time per completed process waiting for memory:          32337.857 ms
Time in CPU per completed process:                      654.3571 ms
Time per completed process waiting for CPU:             191.07143 ms
Time per completed process waiting for IO:              7129.643 ms
Time in Io per completed process:                       9487.357 ms
```