

# Assignment 2

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## Simulation

The Simulation part of the assignment was written in **Haskell** (pure functional programming language). Some of the implementation details are given below:

- We have used **State Monads** to simulate the machine.
- A virtual machine is implemented which requires a scheduler to run.
- The scheduler function requires the readyQueue and returns the pair (selected process, Alloted Burst time).
- The Alloted burst time is same as the next CPU burst for all the schedulers except round robin.
- The time quanta taken for round robin is 6 by default. It can be varied on users choice.
- The parameters to generate the initial data are varied like heavy CPU bound processes or IO bound processes .
- An assumption is made that the process starts with a CPU burst and ends with a CPU burst . So the number of CPU bursts is one more than the number of IO bursts.

We have written a python script to generate the distributions for inter arrival times , priority , IO and CPU bursts

- The most popular and fast python library called NumPy was used to generate these distributions.
- The value of  $\lambda$  for exponential and poisson distributions is taken to be 10. IO Bursts are taken from uniform distribution in the range 0 to 9. Besides, the uniform distribution for generating priorities is from the range 0 to 9. Number of processes is  $N = 20$ . Number of cpu bursts is 500 and io burst is 499.

We have drawn charts also using the **haskell chart library** . We have shown the Bar graph comparison of average response , turnaround and waiting times for all the standard algorithms. To run use the following steps .

- python *seed\_data.py*
- runhaskell *process.hs*

- runhaskell *drawBar.hs*
- runhaskell *drawBarP.hs*
- runhaskell *drawChart.hs*

Then we have shown the comparison of average response ,waiting and turnaround times for three priority categories

## NACH OS

- Our system can run upto 16 threads at the same time without crashing. Thereafter the behaviour is erratic as documented in the source code.
- The kernel is made preemptive by using timer interrupts every 100 ticks. Every 100 ticks , `Alarm::CallBack()`, our timer interrupt handler is called.
- The main thread must have a response time of 0. There after the minimum response time is 10 ms due to context switching. Process with priority 9 is guaranteed to have a response time of 10 ms.
- Our implementation consists of multi level queues , `highQueue` for priority 9 process , `midQueue` for process between priority 5 and 8 , and the lower priority processes are put in `lowQueue`.
- Excluding the time spent in servicing priority 9 processes , the cpu spends 80 percent time in mid queue and 20 percent time in low queue.
- This and rr scheduling guarantees that mid queue processes will have a finite response time.
- The idea of cpu time division between mid and low queues makes the scheduler realistic and saves the low priority processes from starvation.

## STATS

- Thread Name : child TotalTicks : 261 PID : 4 Priority : 7 Burst Time : 38 Arrival Time : 213 Response Time : 10 Waiting Time : 10 Turnaround Time : 48  
Thread Name : main TotalTicks : 310 PID : 0 Priority : -1 Burst Time : 138 Arrival Time : 0 Response Time : 0 Waiting Time : 172 Turnaround Time : 310  
Thread Name : child TotalTicks : 586 PID : 2 Priority : 9 Burst Time : 170 Arrival Time : 35 Response Time : 10 Waiting Time : 10 Turnaround Time : 551  
Thread Name : child TotalTicks : 728 PID : 3 Priority : 4 Burst Time : 116 Arrival Time : 68 Response Time : 61 Waiting Time : 113 Turnaround Time : 660  
Thread Name : child TotalTicks : 951 PID : 5 Priority : 7 Burst Time : 96 Arrival Time : 548 Response Time : 38 Waiting Time : 258 Turnaround Time : 403  
Thread Name : child TotalTicks : 1051 PID : 6 Priority : 4 Burst Time : 96 Arrival Time : 638 Response Time : 41 Waiting Time : 79 Turnaround Time : 413
- Thread Name : child TotalTicks : 261 PID : 4 Priority : 9 Burst Time : 38 Arrival Time : 213 Response Time : 10 Waiting Time : 10 Turnaround Time : 48  
Thread Name : main TotalTicks : 310 PID : 0 Priority : -1 Burst Time : 138 Arrival Time : 0 Response Time : 0 Waiting Time : 172 Turnaround Time : 310

Thread Name : child TotalTicks : 731 PID : 2 Priority : 1 Burst Time : 170 Arrival Time : 35 Response Time : 10 Waiting Time : 167 Turnaround Time : 696

Thread Name : child TotalTicks : 752 PID : 3 Priority : 6 Burst Time : 136 Arrival Time : 68 Response Time : 10 Waiting Time : 114 Turnaround Time : 684

Thread Name : child TotalTicks : 854 PID : 5 Priority : 2 Burst Time : 86 Arrival Time : 548 Response Time : 10 Waiting Time : 182 Turnaround Time : 306

Thread Name : child TotalTicks : 954 PID : 6 Priority : 7 Burst Time : 86 Arrival Time : 641 Response Time : 10 Waiting Time : 10 Turnaround Time : 313

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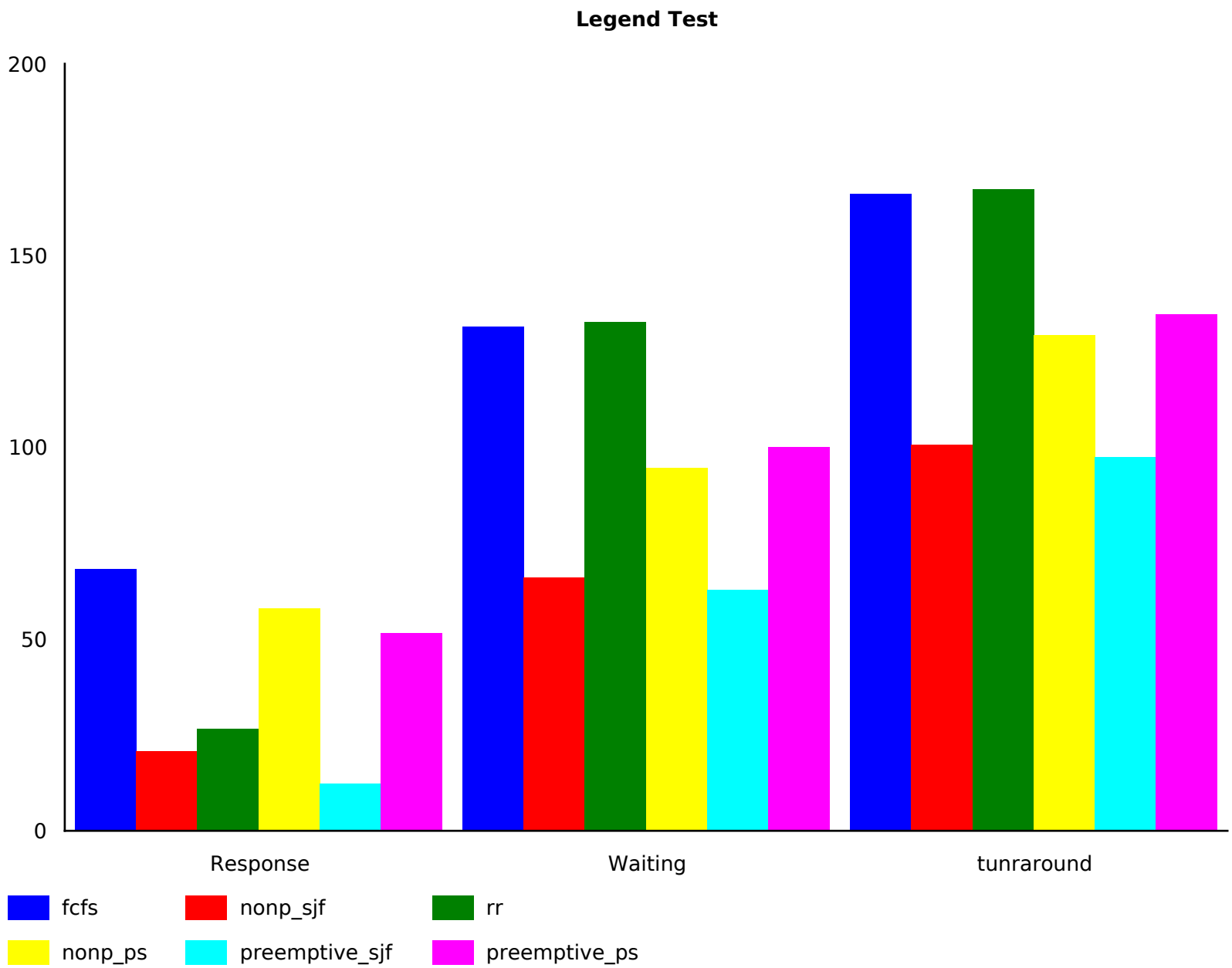


Figure 1: *Averages . Preemptive sjf clearly perform better than others . Round robin has a good response time*

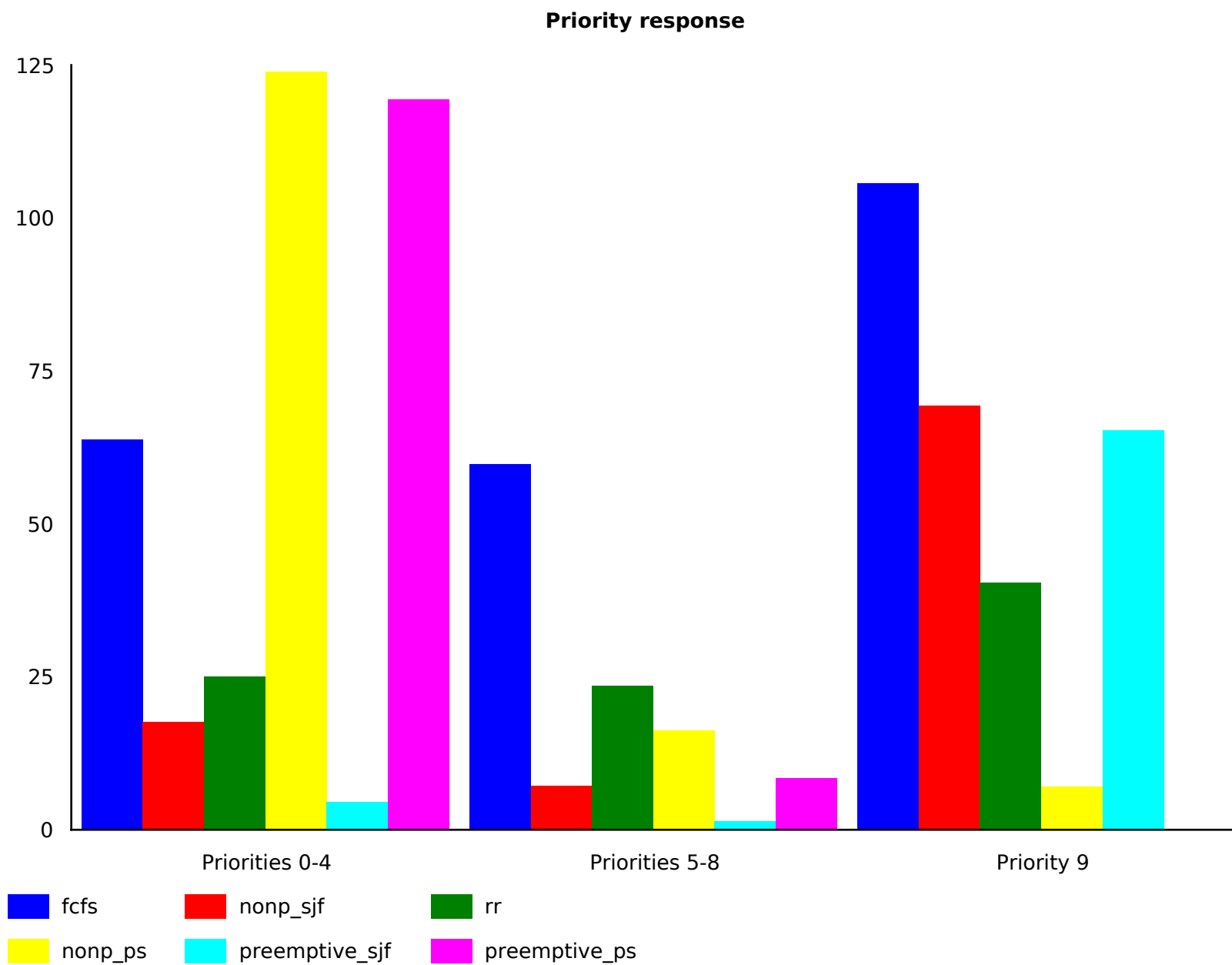


Figure 2: *Average Response time . It can be clearly seen that the average response time for priority 9 is zero for preemptive priority scheduling*

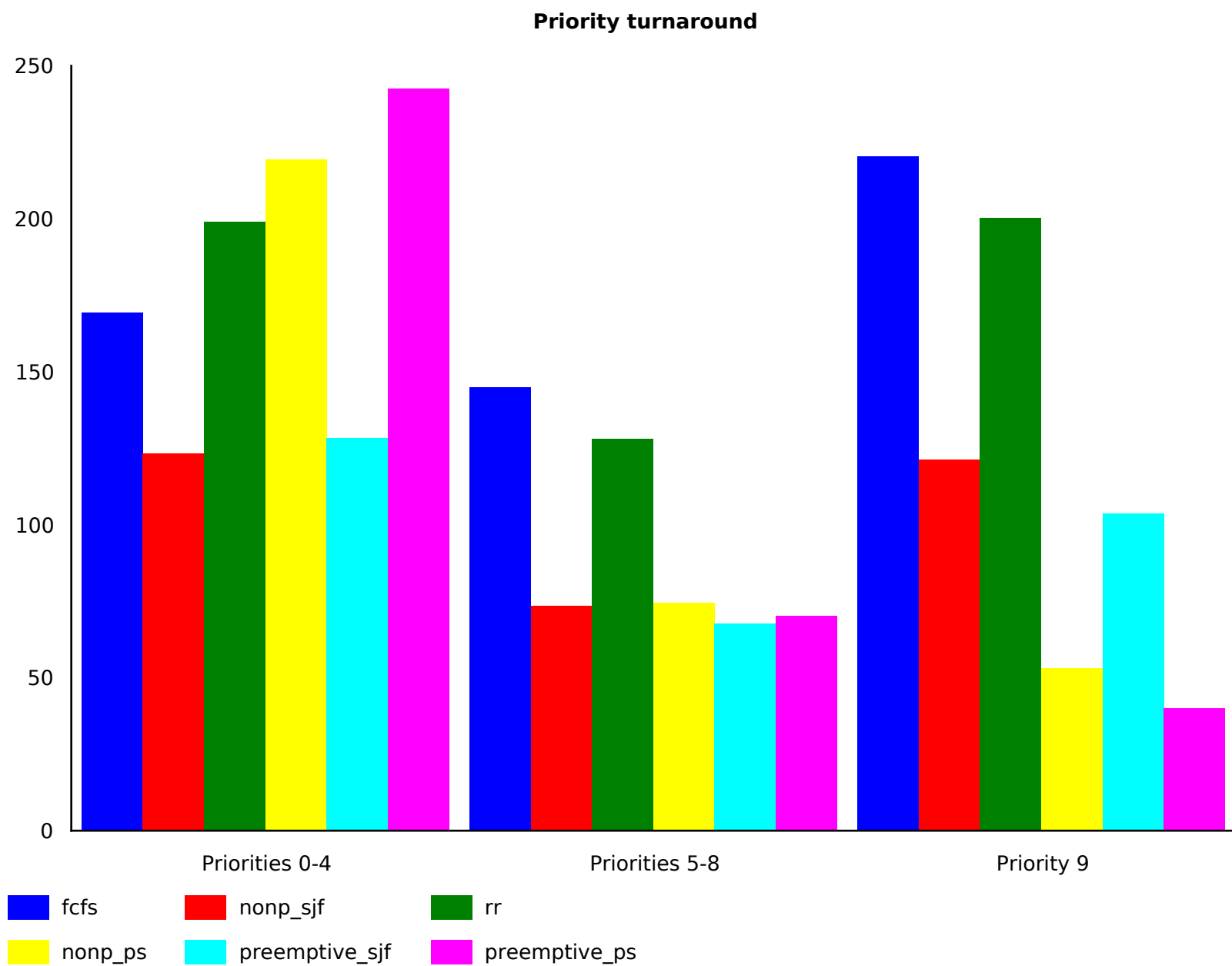


Figure 3: *Average turnaround time. Again preemptive priority scheduling for priority 9 beats other*

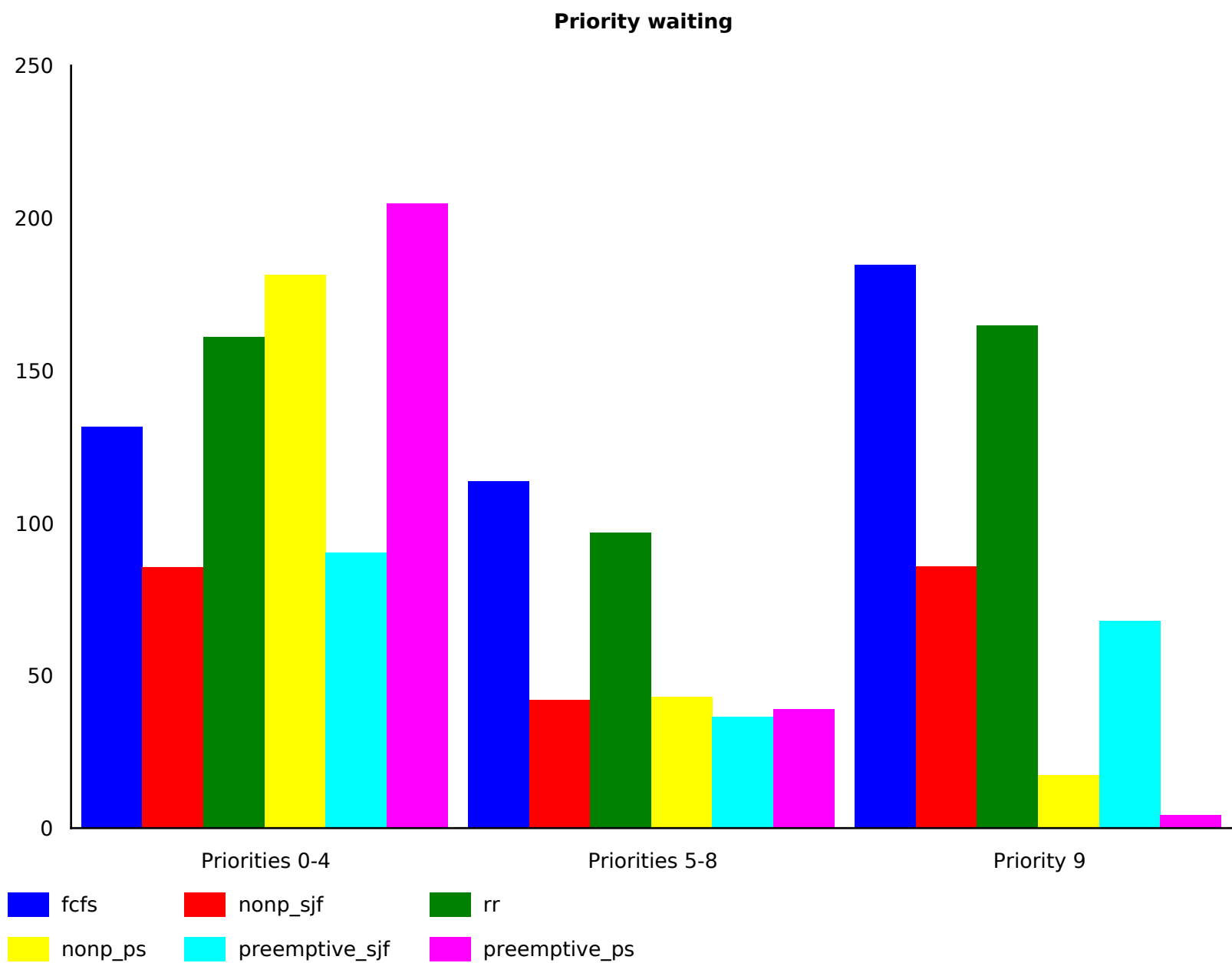


Figure 4: *Average waiting time*