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DS 210  
Homework 6  
28 October 2022

## Question 1:

### Cargo run

```
/Users/benkahan/.cargo/bin/cargo run --color=always
  Finished dev [unoptimized + debuginfo] target(s) in 0.00s
  Running `target/debug/homework6`
Recursive Fibonacci:
The 1-term is: 1
Time it took: 0ns
The 2-term is: 1
Time it took: 0ns
The 3-term is: 2
Time it took: 0ns
The 4-term is: 3
Time it took: 0ns
The 5-term is: 5
Time it took: 0ns
The 6-term is: 8
Time it took: 0ns
The 7-term is: 13
Time it took: 0ns
The 8-term is: 21
Time it took: 1µs
The 9-term is: 34
Time it took: 1µs
The 10-term is: 55
Time it took: 1µs
The 11-term is: 89
Time it took: 2µs
The 12-term is: 144
Time it took: 2µs
The 13-term is: 233
Time it took: 4µs
The 14-term is: 377
Time it took: 5µs
```

The 15-term is: 610  
Time it took: 9 $\mu$ s  
The 16-term is: 987  
Time it took: 15 $\mu$ s  
The 17-term is: 1597  
Time it took: 23 $\mu$ s  
The 18-term is: 2584  
Time it took: 38 $\mu$ s  
The 19-term is: 4181  
Time it took: 62 $\mu$ s  
The 20-term is: 6765  
Time it took: 158 $\mu$ s  
The 21-term is: 10946  
Time it took: 203 $\mu$ s  
The 22-term is: 17711  
Time it took: 378 $\mu$ s  
The 23-term is: 28657  
Time it took: 497 $\mu$ s  
The 24-term is: 46368  
Time it took: 852 $\mu$ s  
The 25-term is: 75025  
Time it took: 1.203ms  
The 26-term is: 121393  
Time it took: 1.839ms  
The 27-term is: 196418  
Time it took: 3.378ms  
The 28-term is: 317811  
Time it took: 5.854ms  
The 29-term is: 514229  
Time it took: 7.928ms  
The 30-term is: 832040  
Time it took: 14.807ms  
The 31-term is: 1346269  
Time it took: 20.938ms  
The 32-term is: 2178309  
Time it took: 33.23ms  
The 33-term is: 3524578  
Time it took: 56.386ms  
The 34-term is: 5702887  
Time it took: 88.687ms  
The 35-term is: 9227465  
Time it took: 135.34ms  
The 36-term is: 14930352  
Time it took: 223.225ms

The 37-term is: 24157817  
Time it took: 361.216ms  
The 38-term is: 39088169  
Time it took: 574.354ms  
The 39-term is: 63245986  
Time it took: 928.276ms  
The 40-term is: 102334155  
Time it took: 1.514907s  
The 41-term is: 165580141  
Time it took: 2.447851s  
The 42-term is: 267914296  
Time it took: 3.95221s  
The 43-term is: 433494437  
Time it took: 6.445702s  
The 44-term is: 701408733  
Time it took: 10.367097s  
The 45-term is: 1134903170  
Time it took: 17.496006s  
The 46-term is: 1836311903  
Time it took: 27.214138s  
The 47-term is: 2971215073  
Time it took: 44.245941s  
The 48-term is: 4807526976  
Time it took: 69.71894s  
The 49-term is: 7778742049  
Time it took: 114.715193s  
The 50-term is: 12586269025  
Time it took: 185.81651s

Process finished with exit code 0

## Cargo run --release

```
/Users/benkahan/.cargo/bin/cargo run --color=always --release
```

```
Finished release [optimized] target(s) in 0.00s
```

```
Running `target/release/homework6`
```

```
Recursive Fibonacci:
```

```
The 1-term is: 1
```

```
Time it took: 0ns
```

```
The 2-term is: 1
```

```
Time it took: 0ns
```

```
The 3-term is: 2
```

```
Time it took: 0ns
```

The 4-term is: 3  
Time it took: 0ns  
The 5-term is: 5  
Time it took: 0ns  
The 6-term is: 8  
Time it took: 0ns  
The 7-term is: 13  
Time it took: 0ns  
The 8-term is: 21  
Time it took: 0ns  
The 9-term is: 34  
Time it took: 0ns  
The 10-term is: 55  
Time it took: 1 $\mu$ s  
The 11-term is: 89  
Time it took: 1 $\mu$ s  
The 12-term is: 144  
Time it took: 1 $\mu$ s  
The 13-term is: 233  
Time it took: 2 $\mu$ s  
The 14-term is: 377  
Time it took: 2 $\mu$ s  
The 15-term is: 610  
Time it took: 4 $\mu$ s  
The 16-term is: 987  
Time it took: 5 $\mu$ s  
The 17-term is: 1597  
Time it took: 9 $\mu$ s  
The 18-term is: 2584  
Time it took: 15 $\mu$ s  
The 19-term is: 4181  
Time it took: 24 $\mu$ s  
The 20-term is: 6765  
Time it took: 40 $\mu$ s  
The 21-term is: 10946  
Time it took: 64 $\mu$ s  
The 22-term is: 17711  
Time it took: 104 $\mu$ s  
The 23-term is: 28657  
Time it took: 167 $\mu$ s  
The 24-term is: 46368  
Time it took: 271 $\mu$ s  
The 25-term is: 75025  
Time it took: 441 $\mu$ s

The 26-term is: 121393  
Time it took: 737 $\mu$ s  
The 27-term is: 196418  
Time it took: 1.19ms  
The 28-term is: 317811  
Time it took: 1.92ms  
The 29-term is: 514229  
Time it took: 3.104ms  
The 30-term is: 832040  
Time it took: 5.145ms  
The 31-term is: 1346269  
Time it took: 8.002ms  
The 32-term is: 2178309  
Time it took: 13.149ms  
The 33-term is: 3524578  
Time it took: 18.668ms  
The 34-term is: 5702887  
Time it took: 29.355ms  
The 35-term is: 9227465  
Time it took: 56.512ms  
The 36-term is: 14930352  
Time it took: 93.155ms  
The 37-term is: 24157817  
Time it took: 122.151ms  
The 38-term is: 39088169  
Time it took: 203.423ms  
The 39-term is: 63245986  
Time it took: 354.627ms  
The 40-term is: 102334155  
Time it took: 618.642ms  
The 41-term is: 165580141  
Time it took: 864.596ms  
The 42-term is: 267914296  
Time it took: 1.325195s  
The 43-term is: 433494437  
Time it took: 2.277475s  
The 44-term is: 701408733  
Time it took: 3.509604s  
The 45-term is: 1134903170  
Time it took: 5.602472s  
The 46-term is: 1836311903  
Time it took: 8.944207s  
The 47-term is: 2971215073  
Time it took: 14.675118s

The 48-term is: 4807526976

Time it took: 23.486758s

The 49-term is: 7778742049

Time it took: 38.016154s

The 50-term is: 12586269025

Time it took: 61.462185s

Process finished with exit code 0

## Report

From comparing the time figures, it appears that the added flag for release vastly improves the efficiency of the code by a factor for 3 (sampled from my data above).