

Midterm Exam

Work alone. Do not use any notes or books. You have approximately 75 minutes to complete this exam.

Please write your answers on the exam. More paper is available if you need it. Please put your name at the top of each page.

1. Find the running time (20 points)

Below is an algorithm for testing if an array a with n elements contains three elements x , y , and z with $x + y = z$. Classify its running time in big- Θ terms.

```
for i <- 1 to n do
  for j <- 1 to n do
    for k <- 1 to n do
      if a[i]+a[j]=a[k] then
        return YES
return NO
```

2. A simple program (20 points)

Below is a program written in the Random Access Language used in HW3. To refresh your memory, a succinct description of this language is given in the Appendix at the end of this exam. Assume that the memory initially contains the value 1 in all locations. Show the contents of locations 0 through 10 when the program halts.

```
0: LDA 0
1: ADD 0
2: STA 0
3: ADD 0
4: STA 0
5: STI 0
6: SUB 10
7: JNZ 9
8: JMP 4
9: HLT
```

3. Binary numbers (20 points)

For each of the following decimal numbers, write it as a four-bit binary number in two's complement notation, or explain why doing so is not possible.

- 0=
- 1=
- -2=
- 7=
- 11=