# CPSC 354 - REPORT

## The first week of class:

In week 1 we leaned about Lean as a programming language, and it's correlation to discrete math. We also learnt about other proof assistants.
We then shifted our focus to the nng practice questions as you can see below.

LEVEL 5 EXPLANATION:

Discrete math's lemmas tell us that anything added to 0 will give the result of that number itself. So; A+0=A.
Using this we can bring the left hand side down to a+b+c.
From here we can use the property of reflexivity to show that both sides are equal, hence solving the puzzle.

## NNG Solutions

### Level 5 / 8 : Adding zero

Active Goal

Objects:

**a b c** : ℕ

Goal:

$a + (b + 0) + (c + 0) = a + b + c$

```
rw [add_zero]
```

Active Goal

Objects:

**a b c** : ℕ

Goal:

$a + b + (c + 0) = a + b + c$

```
rw [add_zero]
```

Active Goal

Objects:

**a b c** : ℕ

Goal:

$a + b + c = a + b + c$

```
rfl
```

level completed! 🎉

### Level 6 / 8 : Precision rewriting

Objects:

**a b c** : ℕ

Goal:

$a + (b + 0) + (c + 0) = a + b + c$

```
rw [add_zero c]
```

Active Goal

Objects:

**a b c** : ℕ

Goal:

$a + (b + 0) + c = a + b + c$

```
rw [add_zero b]
```

Active Goal

Objects:

**a b c** : ℕ

Goal:

$a + b + c = a + b + c$

```
rfl
```

level completed! 🎉

## Level 7 / 8 : add_succ

**Theorem** `succ_eq_add_one`: For all natural numbers $a$, we have $\mathrm{succ}(a) = a + 1$.

Active Goal

Objects:

n : ℕ

Goal:

succ n = n + 1

```
rw [one_eq_succ_zero]
```

Active Goal

Objects:

n : ℕ

Goal:

succ n = n + succ 0

```
rw [add_succ]
```

Active Goal

Objects:

n : ℕ

Goal:

succ n = succ (n + 0)

```
rw [add_zero]
```

## Level 8 / 8 : 2+2=4

$2 + 2 = 4$.

Active Goal

Goal:

2 + 2 = 4

```
rw[four_eq_succ_three]
```

Active Goal

Goal:

2 + 2 = succ 3

```
rw[three_eq_succ_two]
```

Active Goal

Goal:

2 + 2 = succ (succ 2)

```
rw[two_eq_succ_one]
```

Active Goal

Goal:

succ 1 + succ 1 = succ (succ (succ 1))

```
rw[one_eq_succ_zero]
```

## Level 8 / 8 : 2+2=4

Active Goal

Goal:

succ (succ 0) + succ (succ 0) = succ (succ (succ (succ 0)))

```
rw[succ_eq_add_one]
```

Active Goal

Goal:

succ 0 + 1 + (succ 0 + 1) = succ (succ (succ 0 + 1))

```
rw[one_eq_succ_zero]
```

Active Goal

Goal:

succ 0 + succ 0 + (succ 0 + succ 0) = succ (succ (succ 0 + succ 0))

```
rw[add_succ]
```

Active Goal

Goal:

succ (succ 0 + 0) + succ (succ 0 + 0) = succ (succ (succ (succ 0 + 0)))

```
rw[add_zero]
```

## Level 8 / 8 : 2+2=4

Active Goal

Goal:

succ (succ 0) + succ (succ 0) = succ (succ (succ (succ 0)))

```
rw[add_succ]
```

Active Goal

Goal:

succ (succ (succ 0) + succ 0) = succ (succ (succ (succ 0)))

```
rw[add_succ]
```

Active Goal

Goal:

succ (succ (succ (succ 0) + 0)) = succ (succ (succ (succ 0)))

```
rw[add_zero]
```

Active Goal

Goal:

succ (succ (succ (succ 0))) = succ (succ (succ (succ 0)))

```
rfl
```

level completed! 🎉