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Class Prep 4: 2.3.1 to 2.3.2

Chapter 2: Error Analysis

Section 2.3.1: Round-Off Error and Machine Epsilon

```
.Machine$double.eps
```

```
## [1] 2.220446e-16
```

```
print(1 + .Machine$double.eps, digits = 20)
```

```
## [1] 1.0000000000000002
```

```
print(1 + .Machine$double.eps * 2, digits = 20)
```

```
## [1] 1.0000000000000004
```

```
print(1 + .Machine$double.eps / 2, digits = 20)
```

```
## [1] 1
```

```
.Machine$double.neg.eps
```

```
## [1] 1.110223e-16
```

```
print(1 - .Machine$double.neg.eps, digits = 20)
```

```
## [1] 0.99999999999999989
```

```
print(1 - .Machine$double.neg.eps * 2, digits = 20)
```

```
## [1] 0.99999999999999978
```

```
print(1 - .Machine$double.neg.eps / 2, digits = 20)
```

```
## [1] 1
```

```
print(1000 + .Machine$double.eps, digits = 20)
```

```
## [1] 1000
```

```
library(pracma)

eps(1000)

## [1] 1.136868e-13

eps(1000000)

## [1] 1.164153e-10

eps(1000000000)

## [1] 1.192093e-07
```

Section 2.3.2: Loss of Significance

```
1 / 3 - 0.333333333333333
```

```
## [1] 3.330669e-16
```

```
1 - 0.999999999999999
```

```
## [1] 9.992007e-16
```

```
(1 - 0.999999999999999) * 1000
```

```
## [1] 9.992007e-13
```

```
20.55 - 19.2 - 1.35
```

```
## [1] 1.332268e-15
```

```
20.55 - 1.35 - 19.2
```

```
## [1] 0
```

```
quadratic <- function(b2, b1, b0) {
  t1 <- sqrt(b1^2 - 4 * b2 * b0)
  t2 <- 2 * b2

  x1 <- - (b1 + t1) / 2
  x2 <- - (b1 - t1) / 2

  return(c(x1, x2))
}

quadratic2 <- function(b2, b1, b0) {
  t1 <- sqrt(b1^2 - 4 * b2 * b0)
  t2 <- 2 * b0

  x1 <- t2 / (-b1 - t1)
  x2 <- t2 / (-b1 + t1)

  ## Reverse the order so they come
  ## back the same as quadratic()
  return(c(x2, x1))
}

b2 <- 94906265.625
b1 <- 189812534.000
b0 <- 94906268.375

print(quadratic(b2, b1, b0), digits = 20)

## [1] -94906267 -94906267

print(quadratic2(b2, b1, b0), digits = 20)

## [1] -1.000000014487979 -1.000000014487979
```