DATA605 Homework1

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Homework Assignment 1

Problem Set 1

1. Calculate the dot product u.v where u = [0.5;0.5] and v = [3; -4]

Answer: by using %*% operator to do dot product

```
u = c(0.5, 0.5)
v = c(3,-4)

dot_product <- u %*% v
dot_product
```

```
##      [,1]
## [1,] -0.5
```

2. What are the lengths of u and v? Please note that the mathematical notion of

the length of a vector is not the same as the computer science definition.

Answer:

```
# math wise finidng the magnitude of a vector
mag_u <- sqrt(u[1]^2 + u[2]^2)
mag_v <- sqrt(v[1]^2 + v[2]^2)

c(mag_u, mag_v)
```

```
## [1] 0.7071068 5.0000000
```

3. What is the linear combination: 3u - 2v?

Answer:

```
3*u - 2*v
```

```
## [1] -4.5  9.5
```

4. What is the angle between u and v?

Answer: The angle θ between them is defined as

$\theta = arccos(u * v/(||u|| * ||v||))$ (arc cosine of the inner product of

the two vectors divided by the product of their norms)

```r
angle <- acos(dot_product / (mag_v * mag_u)) * (180 / pi) # in degrees
angle
```

```
##          [,1]
## [1,] 98.1301
```

Problem Set 2

Create a function that solves a system of equations (3 variables and 3 constraints)

```r
solveSLE <- function(A, b){
  # get dimensions of matrix A
  m <- cbind(A,b)
  m_row <- nrow(m)
  n_col <- ncol(m)
  pivot <- 1

  for(r in 1:m_row) {
    if ( n_col <= pivot ) break; # if only one column or less, exit
    i <- r
    while( m[i,pivot] == 0 ) { # for entries for 0
      i <- i + 1 # go to next row
      if ( m_row == i ) { # find pivot
        i <- r
        pivot <- pivot + 1 # move pivot until m[i,pivot] is not zero
        if ( n_col == pivot ) return(m)
      }
    }
    # swap rows (next three lines)
    trow <- m[i, ]
    m[i, ] <- m[r, ]
    m[r, ] <- trow
    m[r, ] <- m[r, ] / m[r, pivot]
    for(i in 1:m_row) {
      if ( i != r )
        m[i, ] <- m[i, ] - m[r, ] * m[i, pivot] # row operations
    }
    pivot <- pivot + 1
  }
  return(m[,n_col]) # last column is the x coefficients
}

# test out function
A <- matrix(nrow = 3, ncol = 3, data = c(1, 2, -1, 1, -1, -2, 3, 5, 4))
b <- c(1, 2, 6)
solveSLE(A, b)
```

```
## [1] -1.5454545 -0.3181818  0.9545455
```