

MAE 136 Bonus Assignment 2

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```
# import required packages
library(dplyr)
library(ggplot2)
```

```
### constants ###
Uinf = 1
Lambda = 1
```

```
# create df
x <- seq(-1, 1, 0.01)
y <- seq(-1, 1, 0.01)
```

```
# fill in stream function for each point
df <- data.frame()
```

```
for (i in x){
  for (j in y){
    r = sqrt(i^2 + j^2)
    theta = atan2(j, i)

    stream <- ((Lambda/(2*pi))*theta) + Uinf*r*sin(theta)
    df <- rbind(df, c(stream, i, j))
  }
}
names(df) <- c("stream", "x", "y")
```

```
### body ###
thetas <- seq(0, 2*pi, 0.01)
```

```
wing <- data.frame()
Cpdf <- data.frame()
```

```
for (theta in thetas){
  r <- (0.5 - (theta / (2 * pi))) / sin(theta)
  wing <- rbind(wing, c(x = r*cos(theta), y = r*sin(theta)))

  # for part b #
  Vr <- (1/r)*((Lambda/(2*pi))+(Uinf*r*cos(theta)))
  Vtheta <- -Uinf*sin(theta)
  V <- sqrt((Vr^2) + (Vtheta^2))
  Cp <- 1 - ((V/Uinf)^2)

  Cpdf <- rbind(Cpdf, c(Cp, theta))
}
names(wing) <- c("x", "y")
wing <- filter(wing, x <= 1)
```

```
names(Cpdf) <- c("Cp", "theta")
```

```
### create plots ###
```

```
pl1 <- ggplot() +
  #geom_tile(data = df, aes(x = x, y = y, z = stream, fill = stream)) +
  geom_contour(data = df, aes(x = x, y = y, z = stream), binwidth = 0.05) + # geom_tile() #geom_point(aes(colour =
stream))
  geom_path(data = wing, aes(x = x, y = y), size=1.5) +
  xlab("") +
  ylab("") +
  scale_x_continuous(breaks=c()) +
  scale_y_continuous(breaks=c()) +
  theme_bw()
print(pl1)
```

```
pl2 <- ggplot(Cpdf, aes(x = theta, y = Cp)) +
  geom_path(size=1.5) +
  xlab(expression(theta[body])) +
  ylab(expression(Cp[body])) +
  theme_bw()+
  theme(axis.title.y = element_text(size = 16),
        axis.title.x = element_text(size = 16))
print(pl2)
```

```
### End of script ###
```