RNash_Assign13.rmd

Raphael Nash

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1

Write a program to compute the derivative of $f(x) = x^3 + 2x^2$ at any value of x. Your function should take in a value of x and return back an approximation to the derivative of f(x) evaluated at that value. You should not use the analytical form of the derivative to compute it. Instead, you should compute this approximation using limits.

```
f <- function(x) {
  (2*(x**2)) +x**3
}

derivative <- function(x, func) {
  h <- .0000000001
  (f(x+h) - f(x))/h
}



g <- D(f(x) ~ x)

c(derivative(1, f), g(1))
```

```
## [1] 7.000001 7.000000
```

```
c(derivative(2,f),g(2))
```

```
## [1] 20 20
```

2

Now, write a program to compute the area under the curve for the function $3x^2 + 4x$ in the range x = [1; 3]. You should first split the range into many small intervals using some really small Δx value (say 1e-6) and then compute the approximation to the area under the curve.

```
j <- function (x) {
  3*(x**2)+4*x
}

reimann <- function(x_1, x_2, func) {
  delta<- 10**-6
  s <- seq(from=x_1, to=x_2, by = delta )

  area_under_curve <- 0

  for (x in 1:(length(s)-1))  {

    area_under_curve <- (func(s[x]) *delta)  + area_under_curve
```

```
  }

  return (area_under_curve)
}



reimann(1,3,j)
```

```
## [1] 41.99998
```

```
J <- antiD(j(t) ~ t)
J(3)-J(1)
```

```
## [1] 42
```

Images of analytical problems

$$\int \sin(x)\cos(x)\,dx$$

$$f(x) = \cos(x)$$
$$f'(x) = -\sin(x)$$
$$g(x) = \sin(x)$$
$$g'(x) = \cos(x)$$

$$\int f g'\,dx = fg - \int f' g\,dx$$

$$\cos(x)\sin(x) - \int -\sin(x)\sin(x)\,dx$$

$$\cos(x)\sin(x) + \int \sin(x)\sin(x)\,dx$$

$$\cos(x)\sin(x) + \int \tfrac{1}{2}[1-\cos(2x)]\,dx$$

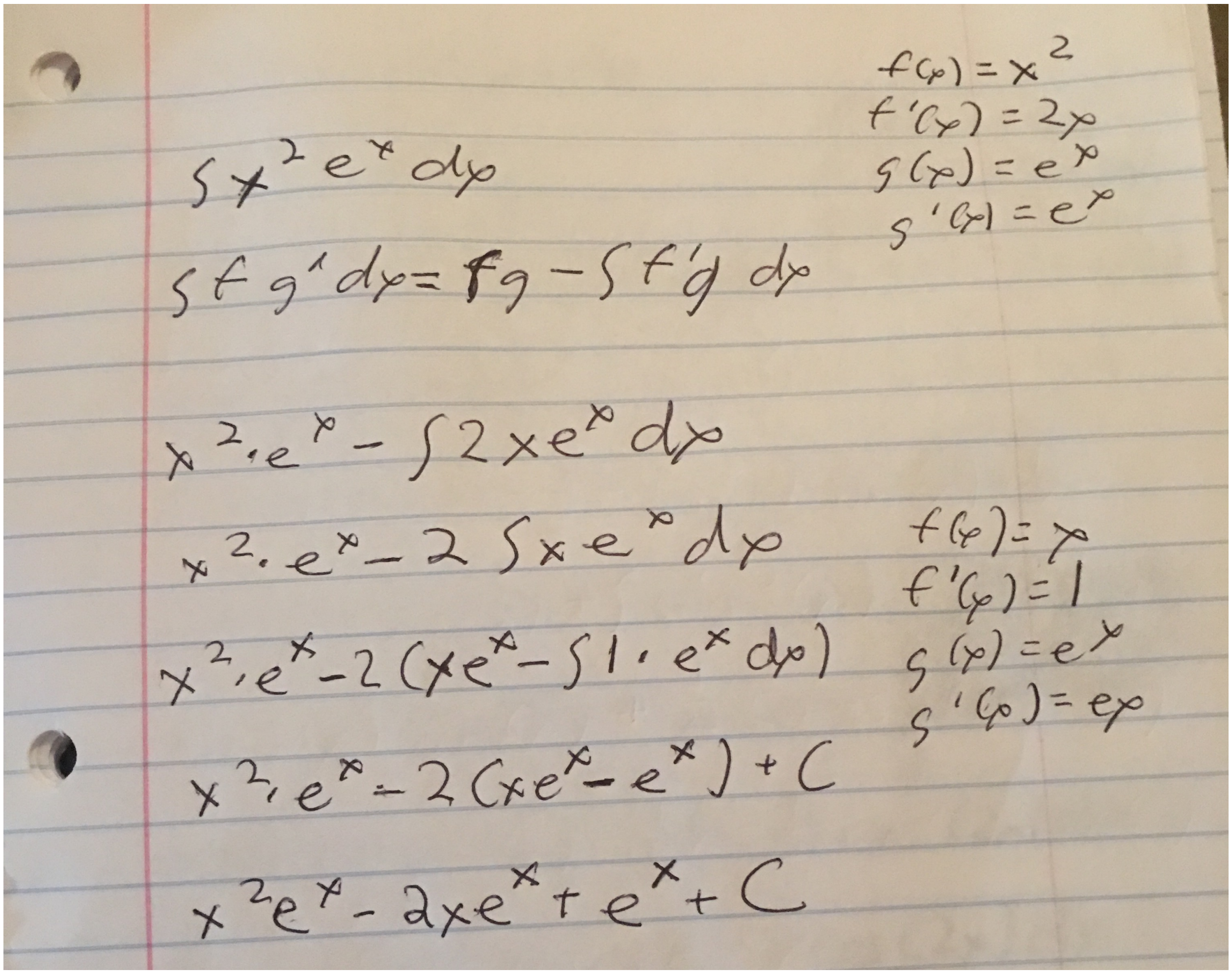
$$\cos(x)\sin(x) + \tfrac{1}{2}\int 1-\cos(2x)\,dx$$

$$\cos(x)\sin(x) + \tfrac{1}{2}\left(\int 1\,dx - \int \cos(2x)\,dx\right)$$

$$\cos(x)\sin(x) + \tfrac{1}{2}\left(x - \int \cos(2x)\,dx\right)$$

$$\cos(x)\sin(x) + \left(\tfrac{1}{2}\left(x + \tfrac{1}{2}(\sin(2x))\right)\right) + ($$

Figure 1:



$\int x^2 e^x dx$

$f(x) = x^2$
$f'(x) = 2x$
$g(x) = e^x$
$g'(x) = e^x$

$\int f g' dx = fg - \int f' g \, dx$

$x^2 \cdot e^x - \int 2x e^x dx$

$x^2 \cdot e^x - 2 \int x e^x dx$

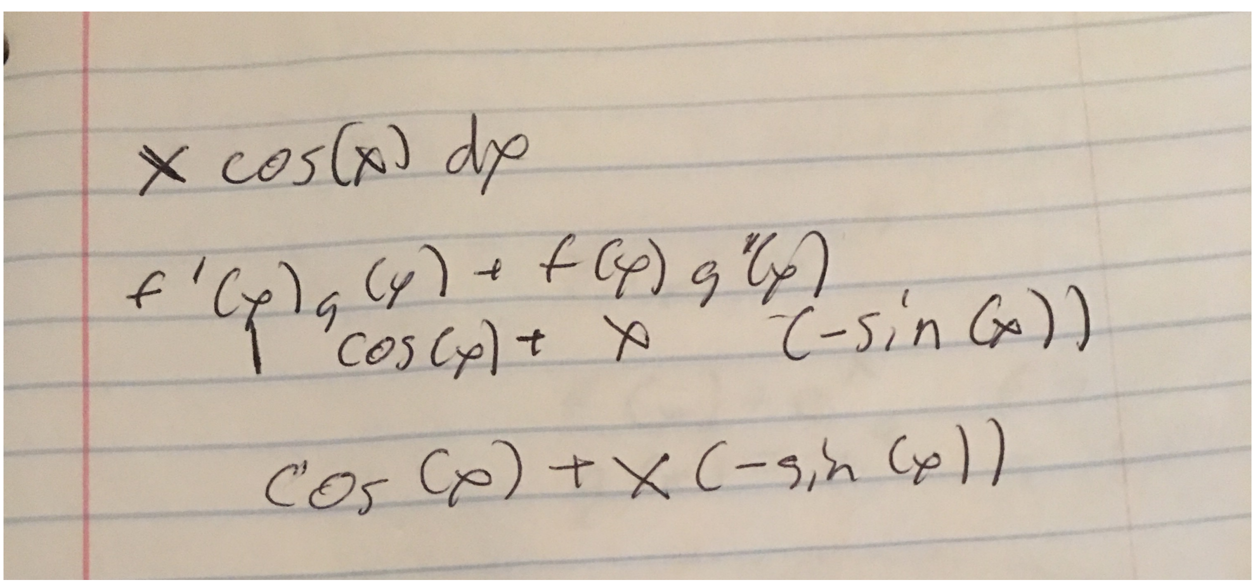
$f(x) = x$
$f'(x) = 1$
$g(x) = e^x$
$g'(x) = ex$

$x^2 \cdot e^x - 2(xe^x - \int 1 \cdot e^x dx)$

$x^2 \cdot e^x - 2(xe^x - e^x) + C$

$x^2 e^x - 2xe^x + e^x + C$

Figure 2:



$x \cos(x) dx$

$f'(x) g(x) + f(x) g'(x)$
$1 \quad \cos(x) + x \quad (-\sin(x))$

$\cos(x) + x(-\sin(x))$

Figure 3:

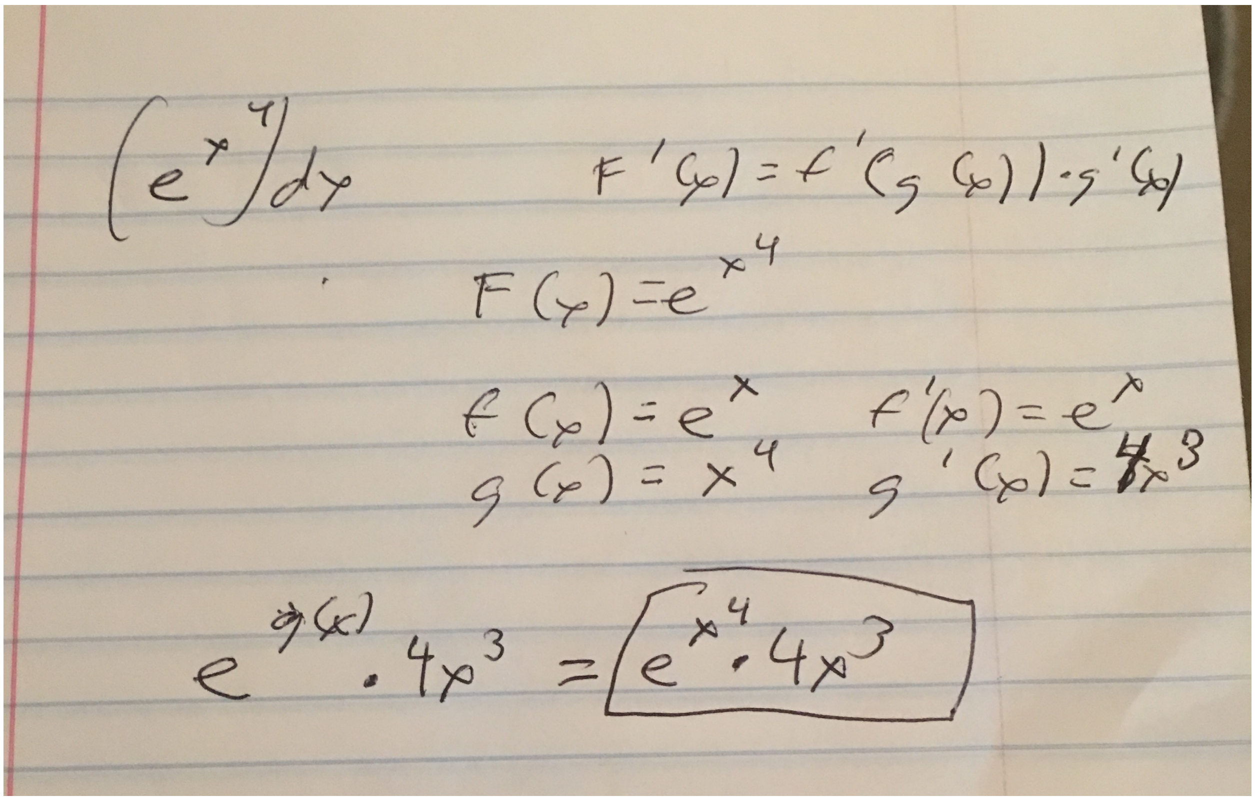

$(e^{x^4})dx$
$F'(x) = f'(g(x)) \cdot g'(x)$
$F(x) = e^{x^4}$
$f(x) = e^x$ $f'(x) = e^x$
$g(x) = x^4$ $g'(x) = 4x^3$
$e^{g(x)} \cdot 4x^3 = \boxed{e^{x^4} \cdot 4x^3}$

Figure 4: