Cheatography

Differentiationgradient of a linem = rise/run = (y2- y1)/(x2 - x1)as limm = (lim h→0) f(x + h) - approaches 0first derivativef(x)/hfirst derivativef(x) = df/dxsecondf'(x) = d^2f/dx^2derivativef''(x)=d^3f/dx^3d/dx rn = nx^n-1d/dx ln(x) - 1/xd/dx e^x = e^xd/dx sin(x) = cos(x)d/dx cos(x) = -si/xyproduct ruley= uvproduct ruley= y(u(x))chain ruley = y(u(x))quotient ruley = u/vy' = u'v - uv'/v²rewrite gradient of line: m= f(x+h) - f(x)/hscalar product rule si a scalar u'(x)+v'(x)			
gradient of a line m = rise/run = (y2- y1)/(x2 - x1) as lim m = (lim h→0) f(x + h) - approaches 0 first derivative f(x) = df/dx first derivative f'(x) = d ² f/dx ² second f''(x) = d ³ f/dx ³ derivative f'''(x) = d ³ f/dx ³ third derivative d/dx ln(x) - 1/x d/dx x ⁿ = nx ⁿ⁻¹ d/dx sin(x) = cos(x) d/dx cos(x) = -six d/dx sin(x) = cos(x) d/dx cos(x) = -six y = uv product rule y = uv frain rule y = y(u(x)) quotient rule y = u/v quotient rule y = u/v scalar product rule y = u/v scalar product rule u'u' - uv'/v ² rewrite gradient of line: m= f(x+h) - f(x)/h where k is a scalar	Differentiation		
as limm = (lim h→0) f(x + h) - f(x)approaches 0f(x)/hfirst derivativef'(x) = df/dxsecondf''(x) = d^2f/dx^2derivativef'''(x)=d^3f/dx^3d/dx x ⁿ = nx ⁿ⁻¹ d/dx ln(x) - 1/xd/dx cos(x) = -six''d/dx sin(x) = cos(x)d/dx cos(x) = -six''y'uv' + vu'product ruley= uvfrian ruley= y(u(x))quotient ruley = u/vquotient ruley = u/vrewrite gradient of line: m= f(x+h) - f(x)/hscalar product rulu/dx (ku(x)) = ku'(x)where k is a scalaru'(x)+v'(x)	gradient of a line	m = rise/run = (y2- y1)/(x2 -x1)	
approaches 0f(x)/hfirst derivative $f'(x) = df/dx^2$ second $f''(x) = d^2f/dx^2$ derivative $f''(x) = d^3f/dx^3$ third derivative $f''(x) = d^3f/dx^3$ d/dx x ⁿ = nx ⁿ⁻¹ $d/dx ln(x) - 1/x$ d/dx e ^x = e ^x $d/dx sin(x) = cos(x)$ d/dx cos(x) = -six/x $y'ux' + vu'$ product rule $y = uv$ product rule $y = y(u(x))$ chain rule $y = y(u(x))$ quotient rule $y = u/v$ quotient rule $y = u/v$ rewrite gradient of line: m= f(x+h) - f(x)/hscalar product rule scalar product rule $y/dx - (u(x) + v(x)) = u'(x) + v(x)$	as lim	m = (lim $h \rightarrow 0$) f(x + h) -	
first derivativef'(x) = df/dxsecondf''(x) = d^2f/dx^2derivativef'''(x)=d^3f/dx^3third derivativef'''(x)=d^3f/dx^3d/dx x ⁿ = nx ⁿ⁻¹ d/dx ln(x) - 1/xd/dx e ^x = e ^x d/dx sin(x) = cos(x)d/dx cos(x) = -sin/xd/dx sin(x) = cos(x)d/dx cos(x) = -sin/xy'uv' + vu'product ruley= uvproduct ruley= y(u(x))chain ruley = y(u(x))quotient ruley = u/vquotient ruley = u/vscalar product ruleu'v - uv'/v²scalar product rulethick (ku(x)) = ku'(x)where k is a scalar derivative of a sur/(x) + v(x)) = u'(x) + v'(x)thick (ku(x) + v(x)) =	approaches 0	f(x)/h	
second f"(x) = d ² f/dx ² derivative f""(x)=d ³ f/dx ³ third derivative f"(x)=d ³ f/dx ³ d/dx x ⁿ = nx ⁿ⁻¹ d/dx ln(x) - 1/x d/dx e ^x = e ^x d/dx sin(x) = cos(x) d/dx cos(x) = -sir(x) y d/dx cos(x) = -sir(x) y product rule y= uv frame y guotient rule y= y(u(x)) quotient rule y= u/v y'= u'v - uv'/v ² rewrite gradient of line: m= f(x+h) - f(x)/h scalar product rule J/dx (ku(x)) = ku'(x) where k is a scalar drivative of a sur/(x)+v'(x) =	first derivative	f'(x) = df/dx	
third derivativef"(x)=d ³ f/dx ³ d/dx x ⁿ = nx ⁿ⁻¹ d/dx ln(x) - 1/xd/dx e ^x = e ^x d/dx sin(x) = cos(x)d/dx cos(x) = -sin(x)yd/dx cos(x) = -sin(x)yproduct ruley= uvproduct ruley = y(u(x))chain ruley = y(u(x))quotient ruley = u/vquotient ruley = u/vrewrite gradient of line: m= f(x+h) - f(x)/hscalar product ruled/dx (ku(x)) = ku'(x)where k is a scalarderivative of a sum d/dx. (u(x)+v(x)) =u'(x)+v'(x)	second derivative	$f''(x) = d^2 f/dx^2$	
d/dx x ⁿ = nx ⁿ⁻¹ d/dx ln(x) - 1/x d/dx e ^x = e ^x d/dx sin(x) = cos(x) d/dx cos(x) = -sin(x) y product rule y= uv product rule y'u' + vu' chain rule y = y(u(x)) quotient rule y = u/v quotient rule y = u/v scalar product rule y' = u'v - uv'/v ² scalar product rule lodx (ku(x)) = ku'(x), where k is a scalar u'(x)+v'(x) u/dx. (u(x)+v(x)) = u'(x)	third derivative	$f'''(x)=d^3f/dx^3$	
d/dx $e^x = e^x$ d/dx $sin(x) = cos(x)$ d/dx $cos(x) = -sin(x)$ $v = cos(x)$ d/dx $cos(x) = -sin(x)$ $y = uv$ product rule $y'uv' + vu'$ chain rule $y = y(u(x))$ dy/dx = dy/du . du/dxquotient rule $y = u/v$ $y' = u'v - uv'/v^2$ rewrite gradient of line: m= f(x+h) - f(x)/hscalar product rule $d/dx (ku(x)) = ku'(x)$ where k is a scalar $drivative of a sum: d/dx. (u(x)+v(x)) = u'(x)+v'(x)$	$d/dx x^{n} = nx^{n-1}$	d/dx ln(x) - 1/x	
d/dx cos(x) = -sin(x) product rule y= uv product rule y'uv' + vu' chain rule y = y(u(x)) dy/dx = dy/du . du/dx dy/dx = dy/du . du/dx quotient rule y = u/v guotient rule y' = u'v - uv'/v ² rewrite gradient of line: m= f(x+h) - f(x)/h scalar product rule // dvx (ku(x)) = ku'(x) where k is a scalar d/dx. (u(x)+v(x)) = u'(x)+v'(x)	$d/dx e^{x} = e^{x}$	$d/dx \sin(x) = \cos(x)$	
product rule y= uv product rule y'uv' + vu' chain rule y = y(u(x)) dy/dx = dy/du . du/dx dy/dx = dy/du . du/dx quotient rule y = u/v guotient rule y' = u'v - uv'/v ² rewrite gradient of line: m= f(x+h) - f(x)/h scalar product rule //dx (ku(x)) = ku'(x) where k is a scalar d/dx. (u(x)+v(x)) = u'(x)+v'(x)	$d/dx \cos(x) = -\sin(x)$		
product rule y= uv v/uv' + vu' y= y(u(x)) chain rule y = y(u(x)) dy/dx = dy/du . du/dx dy/dx = dy/du . du/dx quotient rule y = u/v y' = u'v - uv'/v ² y' = u'v - uv'/v ² rewrite gradient of line: m= f(x+h) - f(x)/h scalar product rule scalar product rule u/dx. (ku(x)) = ku'(x) where k is a scalar u/dx. (u(x)+v(x)) = u'(x)			
y'uv' + vu'chain rule $y = y(u(x))$ dy/dx = dy/du . du/dxquotient rule $y = u/v$ guotient rule $y' = u'v - uv'/v^2$ rewrite gradient of line: m= f(x+h) - f(x)/hscalar product rule $ddx (ku(x)) = ku'(x)$ where k is a scalarderivative of a sum: d/dx. (u(x)+v(x)) =u'(x)+v'(x)	product rule	y= uv	
chain rule $y = y(u(x))$ $dy/dx = dy/du . du/dx$ quotient rule $y = u/v$ $y' = u'v - uv'/v^2$ rewrite gradient of line: m= f(x+h) - f(x)/hscalar product rule $/dx (ku(x)) = ku'(x)$ where k is a scalarderivative of a sum: d/dx. $(u(x)+v(x)) =$ $u'(x)+v'(x)$		y'uv' + vu'	
$\begin{array}{ll} dy/dx = dy/du \ . \ du/dx \\ quotient rule & y = u/v \\ & y' = u'v - uv'/v^2 \\ \hline \\ rewrite gradient of line: m= f(x+h) - f(x)/h \\ scalar product rule d/dx (ku(x)) = ku'(x) \\ where k is a scalar \\ derivative of a sum: d/dx. (u(x)+v(x)) = u'(x)+v'(x) \\ \end{array}$	chain rule	y = y(u(x))	
$\begin{array}{ll} \mbox{quotient rule} & y = u/v & & \\ & y' = u'v - uv'/v^2 & & \\ \mbox{rewrite gradient of line: } m = f(x+h) - f(x)/h & & \\ \mbox{scalar product rule } d/dx \ (ku(x)) = ku'(x) & & \\ \mbox{where } k \ \mbox{is a scalar} & & \\ \mbox{derivative of a sum: } d/dx. \ (u(x)+v(x)) = & \\ u'(x)+v'(x) & & \\ \end{array}$		$dy/dx = dy/du \cdot du/dx$	
$y' = u'v - uv'/v^{2}$ rewrite gradient of line: m= f(x+h) - f(x)/h scalar product rule d/dx (ku(x)) = ku'(x) where k is a scalar derivative of a sum: d/dx. (u(x)+v(x)) = u'(x)+v'(x)	quotient rule	y = u/v	
rewrite gradient of line: m= $f(x+h) - f(x)/h$ scalar product rule d/dx (ku(x)) = ku'(x) where k is a scalar derivative of a sum: d/dx. (u(x)+v(x)) = u'(x)+v'(x)		$y' = u'v - uv'/v^2$	
scalar product rule d/dx (ku(x)) = ku'(x) where k is a scalar derivative of a sum: d/dx. (u(x)+v(x)) = u'(x)+v'(x)	rewrite gradient of line: m= f(x+h) - f(x)/h		

Vectors

$sin(\theta) = opposite/hypotenuse$	
$\cos(\theta)$ = adjacent/hypotenuse	
tan(θ 0= opposite/adjacent	
$a^2+b^2=c^2$	

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Matrices			
C = A+B	addition/s	addition/subtraction	
$B = \square$ $\square A$	<i>k</i> is scalar matrix	r, A is <i>m</i> . <i>n</i>	
$C = \square$ $\square B$	if $A = m$.	$n, B = n \cdot k$	
Trig Functi	ions		
y = a sin(b	x + c) + d	$y = a \cos(bx + c) + d$	
exponentia function	al	$y = e^{x}$	
domain		values x can assume	
range		values y can assume	
amplitude = a period = $2\pi/b$ horizontal shift = - c/b vertical shift = d sin(x) starts at 0, $cos(x)$ starts at one Expon - e = eulers's constant. domain/range : _ (> or <) _			
Logarithmi	c Differenti	ation	
ln(ab) = ln	(a) + ln(b)		
ln(a/b) = ln(a) - ln(b)			
$\ln(a^b) = b \times \ln(a)$			
In(e) = 1			
$e^{\ln(x)} = x$			
Area Betw	een Curve	S	
∫f(x)dx - ∫o	g(x)dx f(x g(x) = upper function (x0 = lower function	
Volume of Revolution	V	$=\pi\int y^2 dx$	
Integrating Ration Functions	f'($x) = x/x^2 - 1$	

Integrals	
∫sin(x)dx	-cos(x) + C
∫cos(x)dx	sin(x) + C
∫e^x dx	e ^x + C
∫1/x dx	ln(x) + C
∫x ⁿ dx	x ⁿ⁺¹ /n+1 + C
∫ln(x) dx	xln(x) - x + C
scalar rule	$\int ku(x) dx = k \int u(x) dx$
integral of a sum	$\int (u(x) + v(x))dx = \int u(x)dx$ $+ \int v(x)dx$
derivative of intergral	d/dx∫u(x)d x= u(x)
integral of derivative	$\int u'(x)dx = u(x) + C$
Integrals of Comn	non Functions

∫sin(nx) dx	-1/n cos(nx) +C
∫cos(nx) dx	1/n sin(nx) = C
∫e ^{nx} dx	1/n e ^{nx} + C
∫ln(nx)dx	1/n ln(nx) + C

Integration by Substitution

 $\int y(u(x))u'(x)dx \qquad \int y(u)du$

Integration by Parts

 $\int uv' dx = uv - \int u'v dx$

 $\int x^{n} dx = x^{n+1}/n+1 + C \text{ only applies when } n$ does NOT equal -1

when n= -1, $\int 1/x \, dx$ applies

Indefinite Integral: no numbers at top of bottom.

Definite Integral: solve for a number that represents the areas under the curve from x=a to x=b

no integration constant in this situation

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rules

product rule: x multiplied together in different forms eg. $y = e^2 e^x$

chain rule:

inner function u(x) outer function: y(u)

looking for function within a function eg. y=ln(sin(x)). *let u equal the inner function*

quotient: x in both the numerator and denominator eq. $y = e^{x}x^{2}$

remember 1/aⁿ = a⁻ⁿ

Functions & Algebraic Structure		
y-intercept: where crosses y	solve for y when x = 0	
roots: where crosses x	solve for x when y = 0	
linear functions	y = mx + c	
quadratic functions	$y = ax^2 + bx + c$	
turning point	x = -b/2 . a	
roots of quadratic	use quadratic formula	
2π = 360°	radians = degrees . π/180	

Function – can have only one output, y, or each unique input, x.

Relation - can have more than one output, y, for each unique input, x.

may be be more than one root for a function. roots can also be called x-intercepts and zeros

linear: mx= gradient/slope C= y-intercept

quadratic: pos a = 'happy face', neg a = 'sad face'



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Explicit/Implicit

Explicit: dependent variable is written explicitly in terms of the independent. *eg.* y = 3x + 5

Implicit: dependent variable is not isolated to one side of equation *eg.* 3x + 5 - y = 0

Explicit differentiation: when starting with implicit from that is rearrangeable, rearrange then do.

Implicit differentiation: relies on the chain rule. No rearranging required

Differential Equations

First Order Separable

f(x) put all x to one side and y to other dx = g(y) dy

Power & Log Rules

 $a^{b} \cdot a^{c} = a^{b+c}$ $a^{b}/a^{c}=a^{b-c}$ $ln(a^{b})=bln(a)$ ln(e) = 1 $e^{ln(x)} = x$ Decay

Decay

 $\label{eq:linear} \begin{array}{ll} dN/dt & N = \text{amount of substance, t} = time \\ = -\lambda N & \text{and } \lambda \text{ is decay constant} \end{array}$

Newton's Law of Cooling

dT/dt	T = Temp of object, Ta is ambient
= -	temp, t is time a k is heat transfer
k(T-	constant
Ta)	

*Motion Problems

v = s = position, v = velocity, a = ds/dt acceleration, t= time

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a = dv/dt

A differential equation is just a mathematical equation that involves derivatives.

can have more than one solution

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