Envisioning Scalar Functions and Their Gradients

http://www.sv.vt.edu/classes/ESM4714/methods/CogVizCmp.html

Scalar Function, F(x,T,t), with three independent variable, x,T, and t

$$F(x,T,t) = \frac{\ln\left[P_1(30-T) + P_2(1-A)^2\right]}{2.5\, P_2(1-A)^2}$$

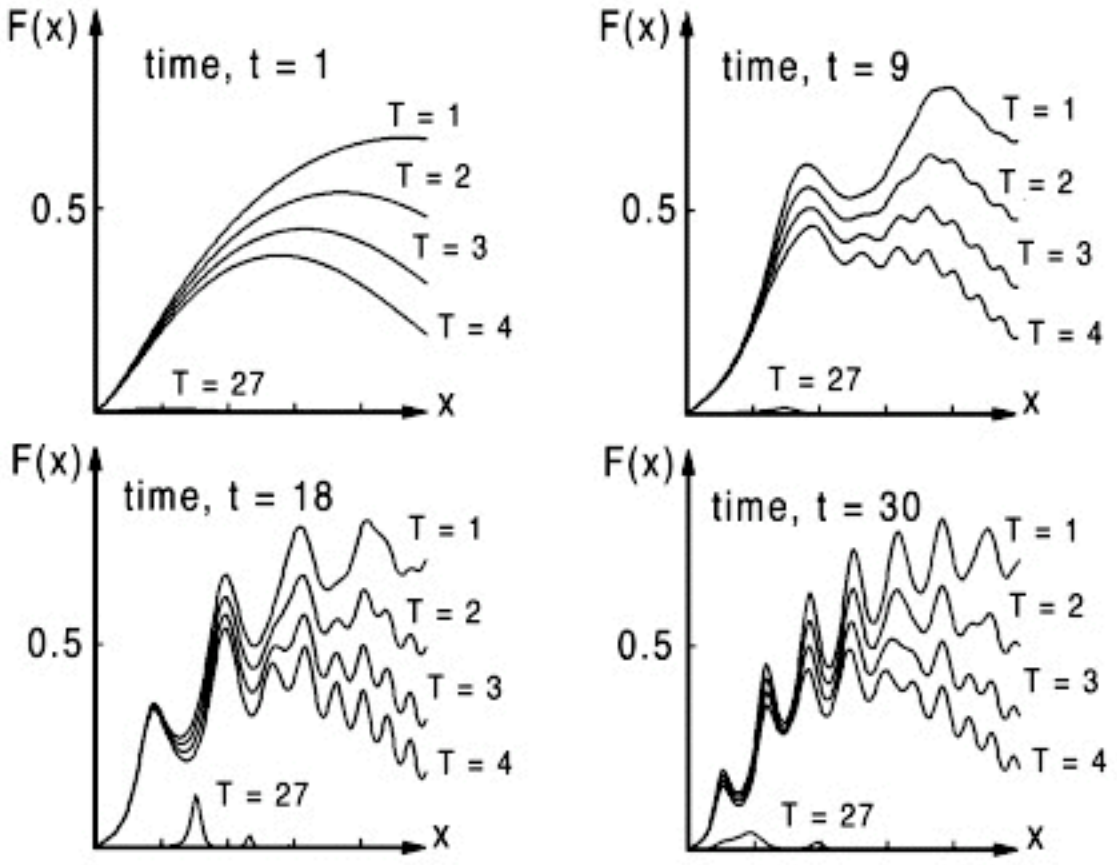
where $A = \frac{5}{4}\sin(t\, L_1\, \pi / 180)\sin(T\, L_2\, \pi / 180)\sin(x\, L_3\, \pi / 180)$

$$P_2 = e^{\{TP_1 + \frac{1}{2}\sin(x\, L_1\, \pi / 180)\}}$$

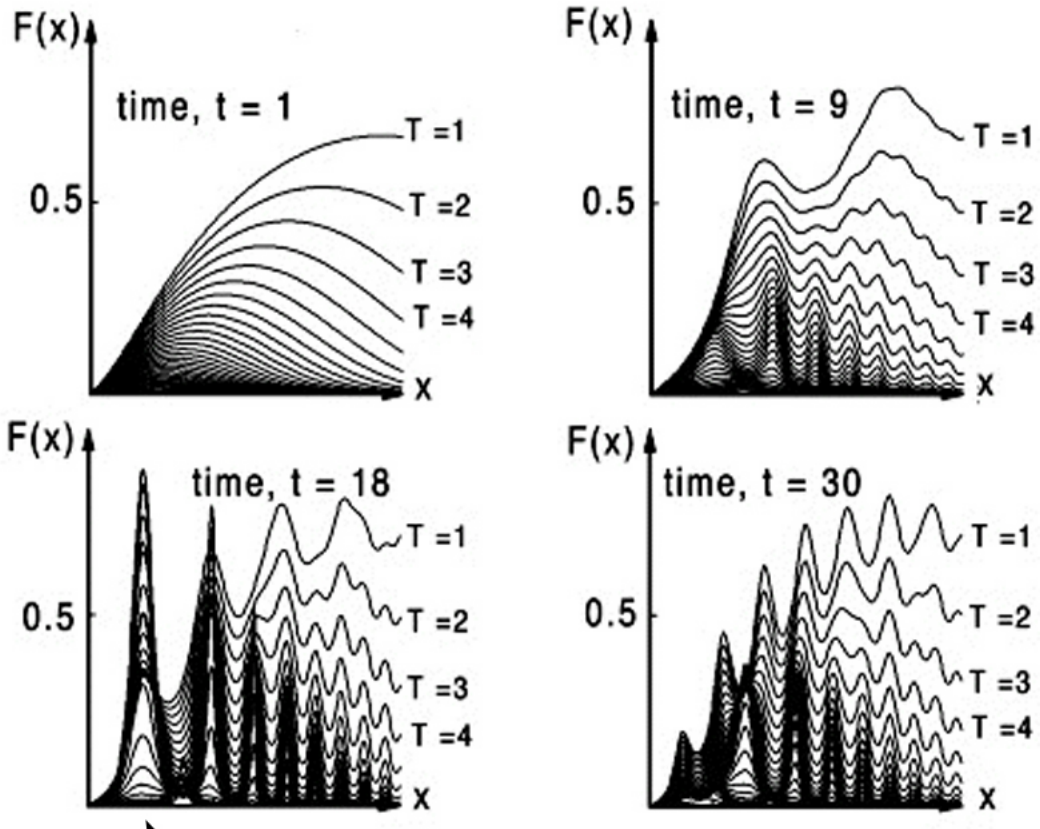
$$P_1 = 0.6\left(\frac{x+1}{360}\right)^2 + 0.05\left(\frac{x+1}{360}\right)$$

$L_1 = t / 4$, $L_2 = T / 3$, $L_3 = x / 45$, $1 \le t \le 30$, $1 \le T \le 30$, $0 \le x \le 360$

Plot most significant results of function F(x,T,t) on a page.

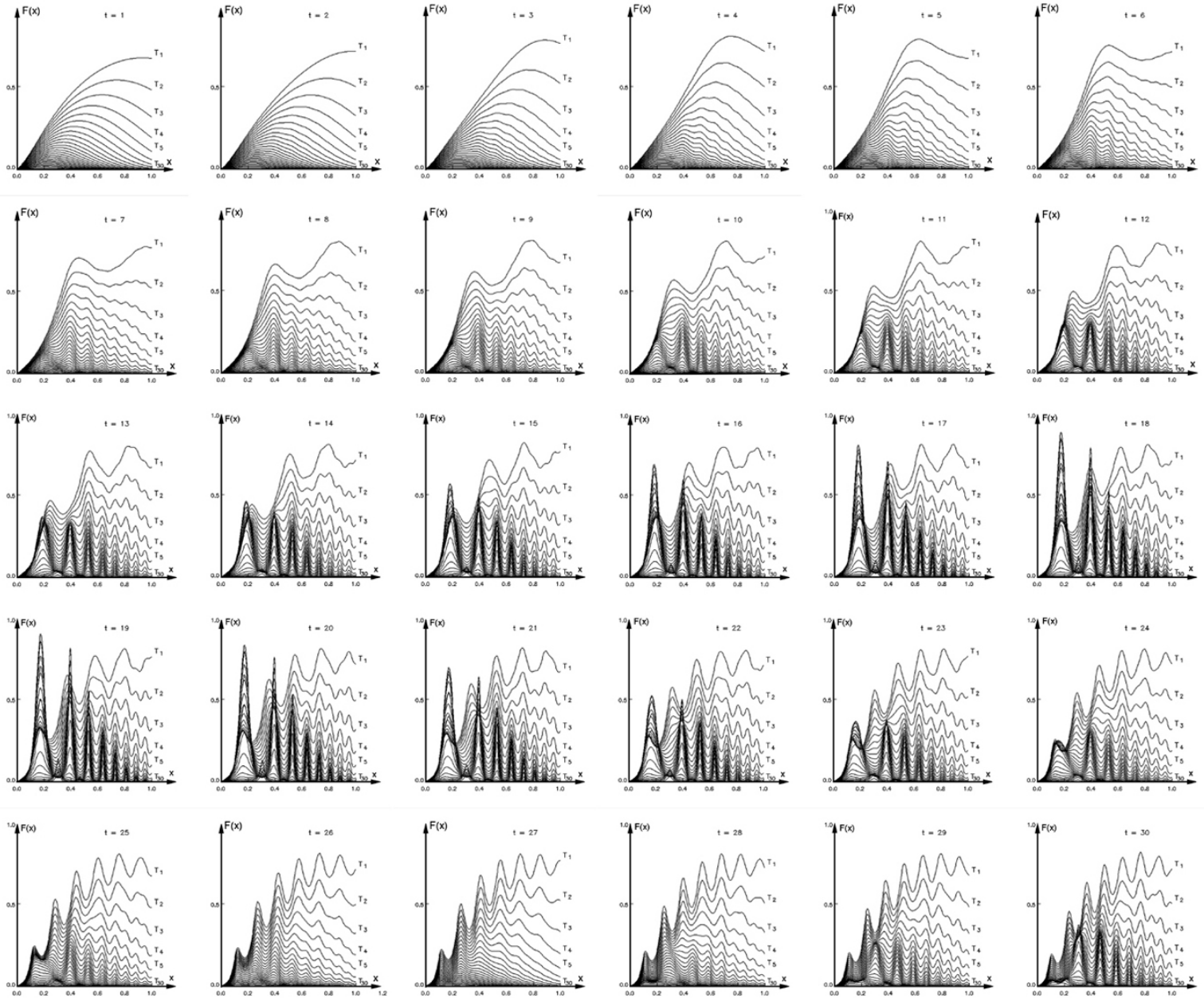


Need more information between
T=4 and t=30

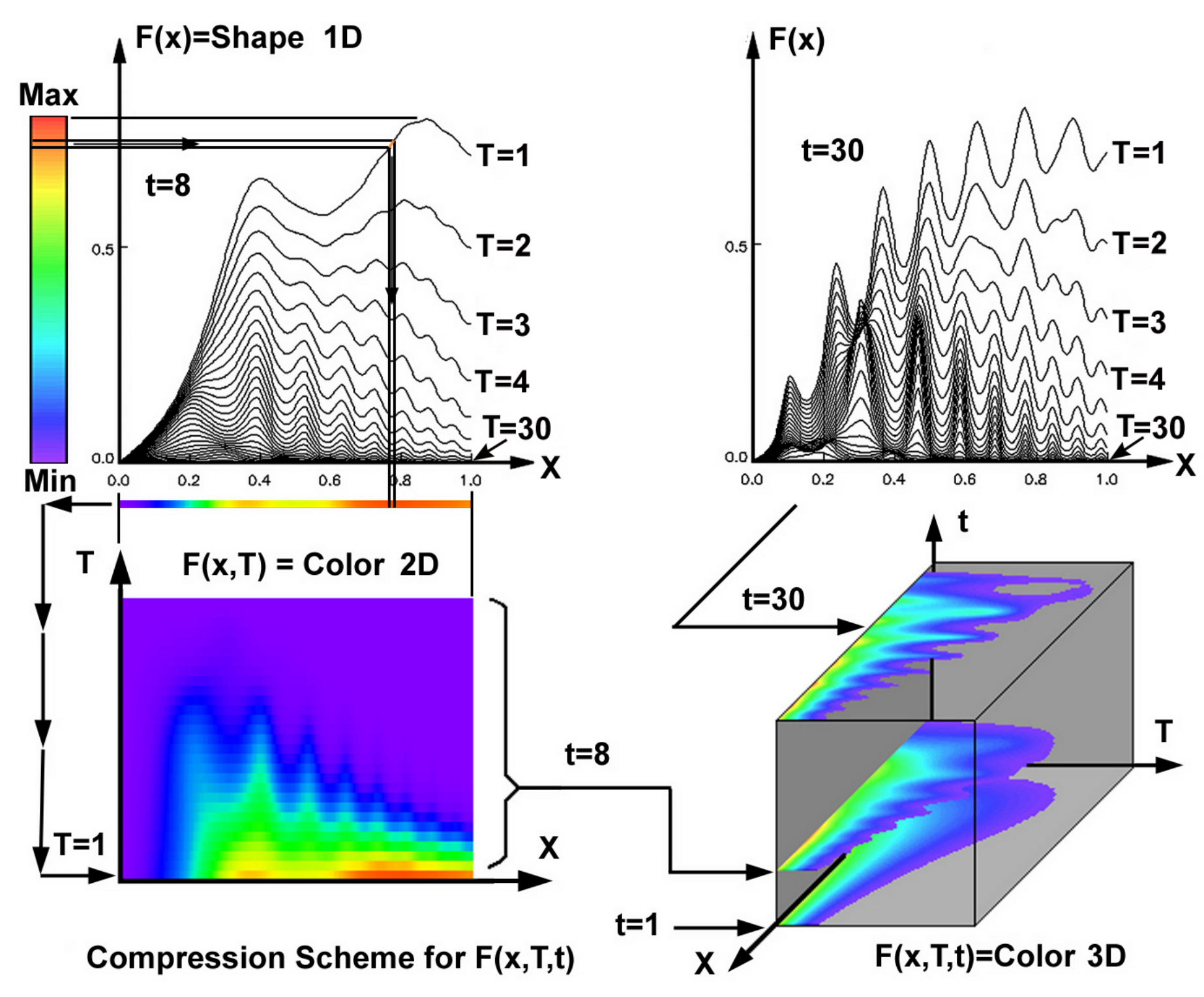


Surprise singularity at t=18 as T approaches 30.
Also need more information for all t.

Thirty plots of F(x,T,t) for t=1 through t=30 (fits on one page)



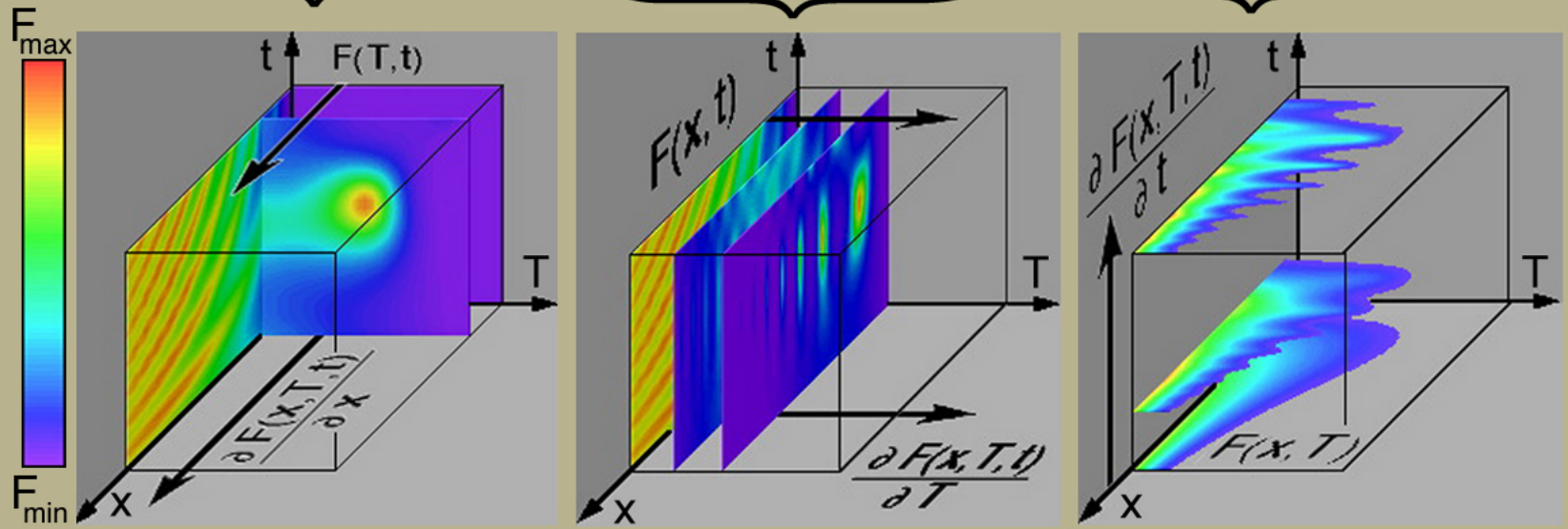
Need to compress this information, if not more, into one plot.


F(x)=Shape 1D
Max
Min
t=8
T=1
T=2
T=3
T=4
T=30
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
X
F(x)
t=30
T=1
T=2
T=3
T=4
T=30
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
X
T
F(x,T) = Color 2D
T=1
X
t=8
t
t=30
T
t=1
X
Compression Scheme for F(x,T,t)
F(x,T,t)=Color 3D

Gradient of a three dimensional scalar function F(x,T,t)

$$\vec{\nabla} F(x,T,t) = \overrightarrow{\text{grad}}\, F(x,T,t) =$$

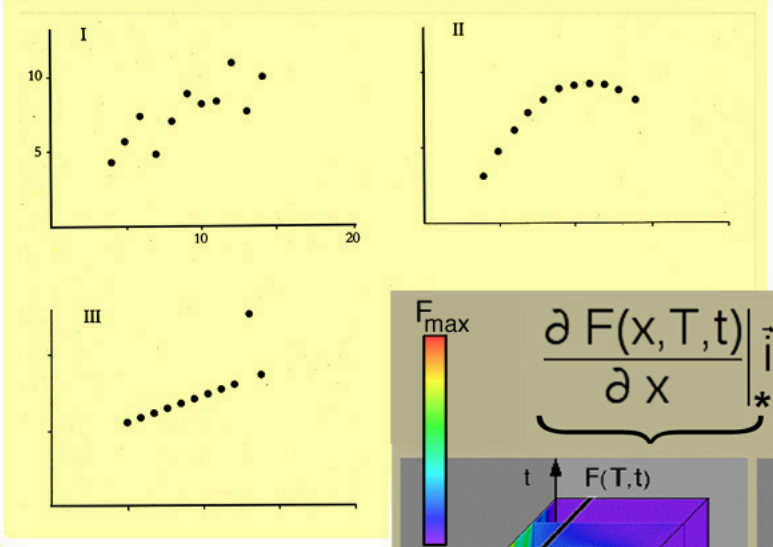
$$\underbrace{\left.\frac{\partial F(x,T,t)}{\partial x}\right|_{*} \vec{i}}_{*} + \underbrace{\left.\frac{\partial F(x,T,t)}{\partial T}\right|_{*} \vec{j}}_{*} + \underbrace{\left.\frac{\partial F(x,T,t)}{\partial t}\right|_{*} \vec{k}}_{*}$$



* **for all points in the plane moving in their respective gradient directions ($\vec{i}$, $\vec{j}$, $\vec{k}$)**

I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0					
6.0	7.24	6.0					
4.0	4.26	4.0					
12.0	10.84	12.0					
7.0	4.82	7.0					
5.0	5.68	5.0					

Tufte [1]



Tables

Late 1700's

Graphs 1D

Late 1900's

Compressed Graphs 3D

MORE COMPARATIVE

MORE QUANTITATIVE