



Changeons & Predictions

(in progress...)

Taylor Series Expansion



■ Taylor Series

- $$f(x) = \sum_{n=0}^{\infty} \frac{f^{(n)}(a)}{n!} (x - a)^n$$

- $$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots, \quad -\infty < x < \infty$$

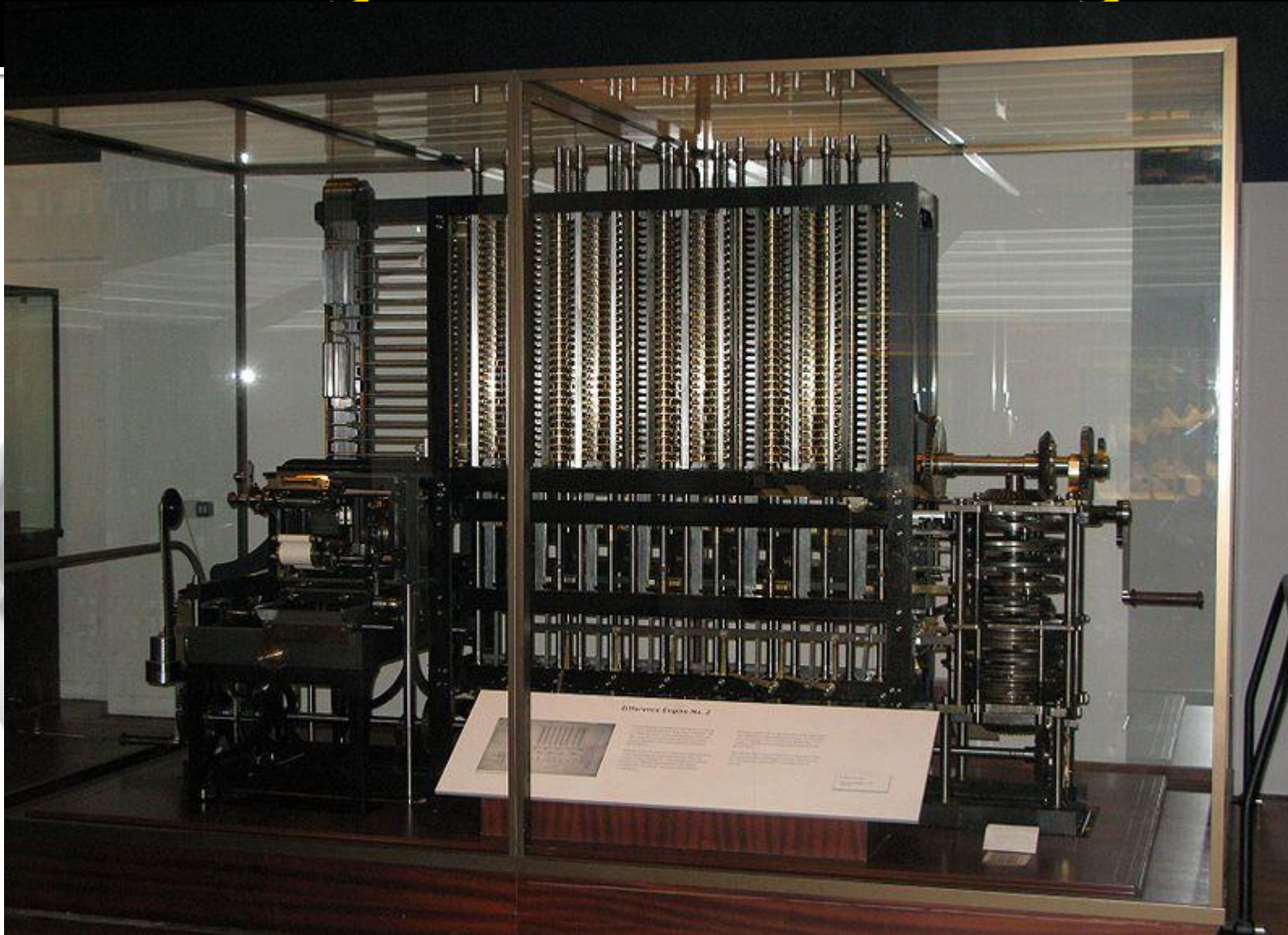
- $$\sim f(x) = \sum_{i=0}^k a_i x^i$$

■ Leads to Newton's Method of Divided Differences

■ Babbage's Difference Engine

- Errors accumulate beyond region $x=a$
- My recurrence relation does not have this problem

Babbage's Difference Engine

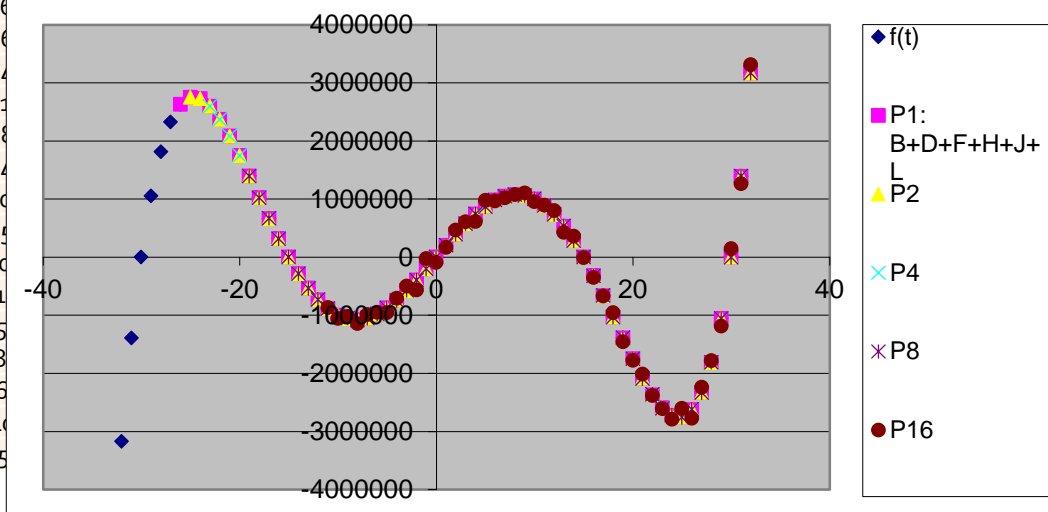


- Babbage's
- Difference Engine

Spreadsheet Difference Engine



t	t+noise	f(t)	P1: B+D+F+H+J+L	P2	P4	P8	d1	P1: D+F+H+J+L	d2	P1: F+H+J+L	d3	P1: H+J+L	d4	P1: J+L	d5
-32	-32	-3170432						0		0		0		0	
-31	-31	-1391776					1778656			0		0		0	
-30	-30	1.102319					1391777		-386879			0		0	
-29	-29	1053976					1053975		-337802		49077.43			0	
-28	-28	1815632					761656		-292319		45482.96		-3594.47		0
-27	-27	2326969					511336.6		-250319		41999.54		-3483.42		111.0513
-26	-26	2626625	2626613				299656.6	299644.4	-211680	-211692	38639.35	38627.18	-3360.19	-3372.37	123.224
-25	-25	2750001	2750004	2749931			123375.9	123378.9	-176281	-176278	35399.35	35402.38	-3240	-3236.97	120.1918
-24	-24	2729376	2729376	2729394			-20624.6	-20625.3	-144001	-144001	32280.18	32279.54	-3119.16	-3119.81	120.8417
-23	-23	2594033	2594033	2594029	2593411		-135343	-135343	-114719	-114719	29281.86	29281.87	-2998.33	-2998.32	120.8356
-22	-22	2370368	2370376	2370376	2370532		-223665	-223658	-88321.5	-88314.3	26397.11	26404.37	-2884.75	-2877.49	113.5775
-21	-21	2082025	2082008	2082051	2082015		-288343	-288360	-64678.4	-64695.6	23643.11	23625.94	-2754	-2771.17	130.7442
-20	-20	1750001	1750023	1749920	1750073		-332024	-332002	-43680.9	-43658.6	20997.47	21019.85	-2645.64	-2623.26	108.367
-19	-19	1392777	1392756	1392890	1392936	1384533	-357224	-357245	-25200	-25220.7	18480.96	18460.2	-2516.51	-2537.27	129.1223
-18	-18	1026432	1026446	1026322	1025830	1028847	-36								
-17	-17	664768.8	664760.5	664844.4	665661.7	664815.8	-36								
-16	-16	319424.6	319433.8	319384.2	318515.4	320367	-34								
-15	-15	0.115379	-12.2014	43.17551	652.1443	1493.435	-35								
-14	-14	-285823	-285815	-285889	-286158	-292885	-28								
-13	-13	-532168	-532164	-532114	-531856	-521243	-24								
-12	-12	-734831	-734849	-734825	-735340	-746243	-20								
-11	-11	-891175	-891151	-891255	-890707	-882686	-15								
-10	-10	-1000000	-1000023	-999874	-1000017	-1004367	-10								
-9	-9	-1061424	-1061411	-1061548	-1061999	-1057791	-61								
-8	-8	-1076768	-1076769	-1076693	-1075784	-1082896	-15								
-7	-7	-1048431	-1048437	-1048444	-1049456	-1042307	28								
-6	-6	-979775	-979765	-979801	-979111	-980628	686								
-5	-5	-874999	-875013	-874951	-875142	-881583	10								
-4	-4	-739024	-739010	-739094	-739214	-727065	135								



Process Network Example



- Automatically generates missing info

- blink
- Optical blind spot

- Continuous Interaction

- Bottom-up
- Top-down

- Incremental Learning of Dynamics

- Not solution
- No substance (weights)
- Adaptive

- Incremental Levels

- Improve accuracy

- No Delay

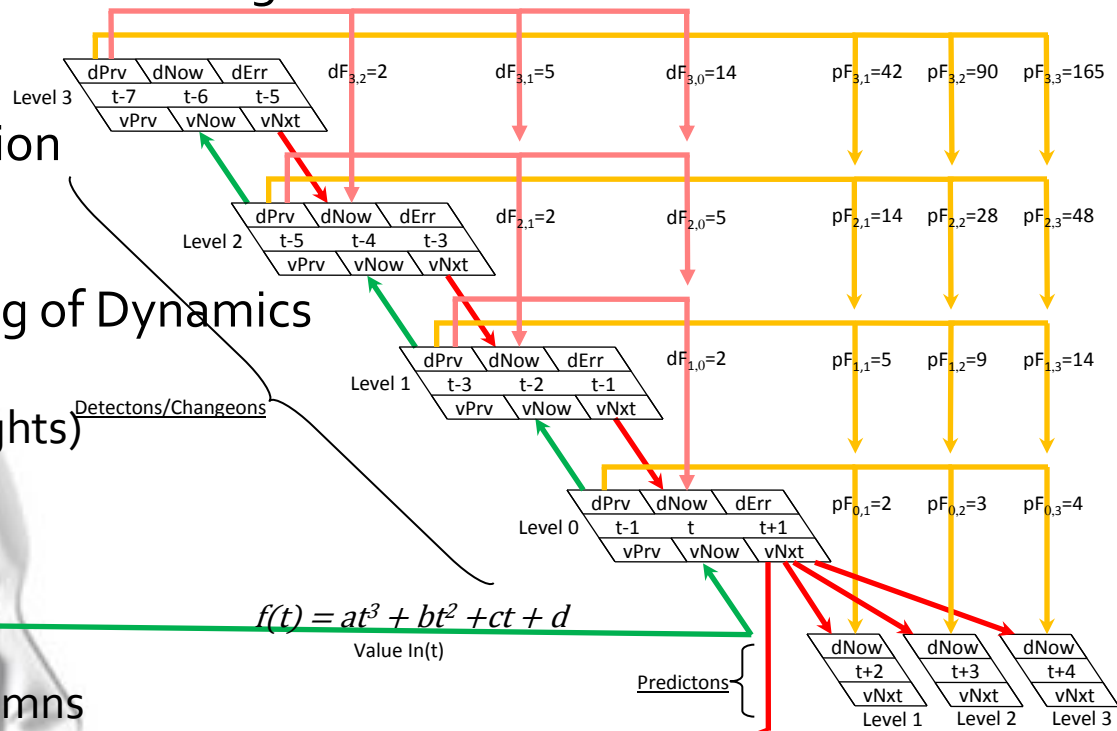
- 8 Spreadsheet Columns

- Delay

- Need Network
- + Efferents

- Far Predictors

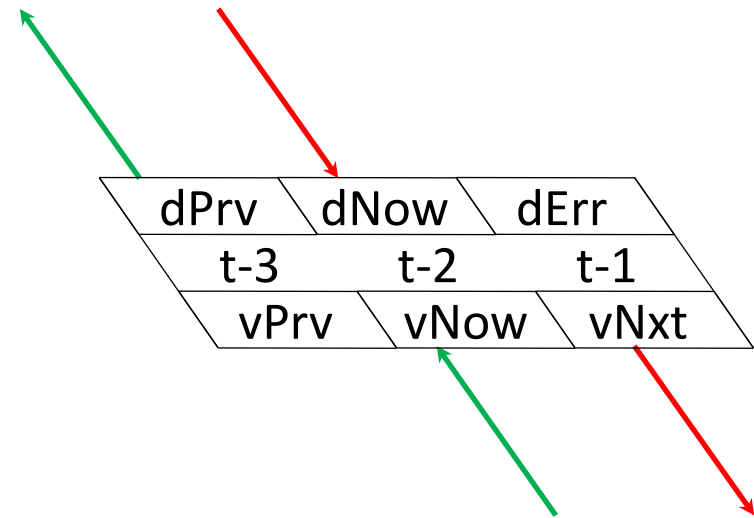
- Not needed



Changeon



- $dPrv_n = vPrv_o - vNow$
- $vPrv_n = vNow$
- $vNxt = vNow + dNow$
- $dErr = vNxt - vNow$
(unused)



Kalman Filter



- Kalman Filter
 - Use: predict values with random noisy measurements over discrete time increments (especially in military radar); sensor fusion; data fusion
 - E.g., phase locked loop
 - Exact inference in a linear dynamical system
 - Weighted average of predicted and measured values (covariance)
 - Bayesian Model over a Hidden Markov Model of latent variable states considered to Gaussian (normal) distribution
 - Recursive filter
 - Predict/update cycles