

# ProtoDocs: Supporting Collaborative Information Visualization

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# Problem

— [ The current state of information visualization tools is that they are complex and difficult to master. Information visualization is still a relatively new field and further work needs to be done to simplify the process of producing visualizations.

— [ Collaboration within the creation of information visualizations is also a relatively new area that needs to be addressed. Many projects deal primarily with collaborative analysis of information visualization

# Related Work

— [ Protovis: A Graphical Toolkit for Visualization (Heer and Bostock)

— [ Voyagers and Voyeurs: Supporting Asynchronous Collaborative Information Visualization (Heer, Viegas and Wattenberg)

— [ Many Eyes (Viegas, Wattenberg, et al)

— [ A Spreadsheet Approach to Information Visualization (Chi, Barry, et al)

# Design

- ProtoDocs

- Protovis

- A powerful open-source graphical toolkit

- Google Docs

- Basic spreadsheet functionality, with the capability to extend the UI through Gadgets

- As a web application, one of its key features is to support collaboration

# Implementation

— Data composition

— Collaborative production of data sets

— Import of raw data from external sources

— Script to convert JSON data formats from Protovis to CSV

```
Data
[
  { year: 1560, wheat: 41, wages: 5 },
  { year: 1570, wheat: 45, wages: 5.08 },
  { year: 1575, wheat: 42, wages: 5.08 },
  { year: 1580, wheat: 49, wages: 5.12 },
  { year: 1585, wheat: 41.5, wages: 5.15 },
  { year: 1590, wheat: 47, wages: 5.25 },
  { year: 1595, wheat: 5, wages: 5.54 },
  { year: 1600, wheat: 27, wages: 5.81 },
  { year: 1605, wheat: 33, wages: 5.89 },
  { year: 1610, wheat: 33, wages: 5.79 },
  { year: 1615, wheat: 33, wages: 5.94 },
  { year: 1620, wheat: 1000, wages: 6.01 },
  { year: 1625, wheat: 33, wages: 6.12 },
  { year: 1630, wheat: 45, wages: 6.22 },
  { year: 1635, wheat: 33, wages: 6.3 },
  { year: 1640, wheat: 39, wages: 6.37 },
  { year: 1645, wheat: 2, wages: 6.45 },
  { year: 1650, wheat: 42, wages: 6.5 },
  { year: 1655, wheat: 40.5, wages: 6.6 },
  { year: 1660, wheat: 46.5, wages: 6.75 },
  { year: 1665, wheat: 32, wages: 6.8 },
  { year: 1670, wheat: 37, wages: 6.9 },
  { year: 1675, wheat: 43, wages: 7 },
  { year: 1680, wheat: 36, wages: 7.3 },
  { year: 1685, wheat: 27, wages: 7.6 },
  { year: 1690, wheat: 40, wages: 8 },
  { year: 1695, wheat: 50, wages: 8.5 },
  { year: 1700, wheat: 30, wages: 9 },
  { year: 1705, wheat: 32, wages: 10 },
  { year: 1710, wheat: 44, wages: 11 },
  { year: 1715, wheat: 33, wages: 11.75 },
  { year: 1800, wheat: 75, wages: 28.5 }
]
```

year	wheat	wages
1560	41	5
1570	45	5.08
1575	42	5.08
1580	49	5.12
1585	41.5	5.15
1590	47	5.25
1595	5	5.54
1600	27	5.81
1605	33	5.89
1610	33	5.79
1615	33	5.94
1620	1000	6.01
1625	33	6.12
1630	45	6.22
1635	33	6.3
1640	39	6.37
1645	2	6.45
1650	42	6.5
1655	40.5	6.6
1660	46.5	6.75
1665	32	6.8
1670	37	6.9
1675	43	7
1680	36	7.3
1685	27	7.6
1690	40	8
1695	50	8.5
1700	30	9
1705	32	10
1710	44	11
1715	33	11.75
1800	75	28.5

# Implementation

The screenshot displays a Google Docs spreadsheet titled "Job Voyager" with a data table. The table has columns for years from 1850 to 1940 and rows for various professions. The data is as follows:

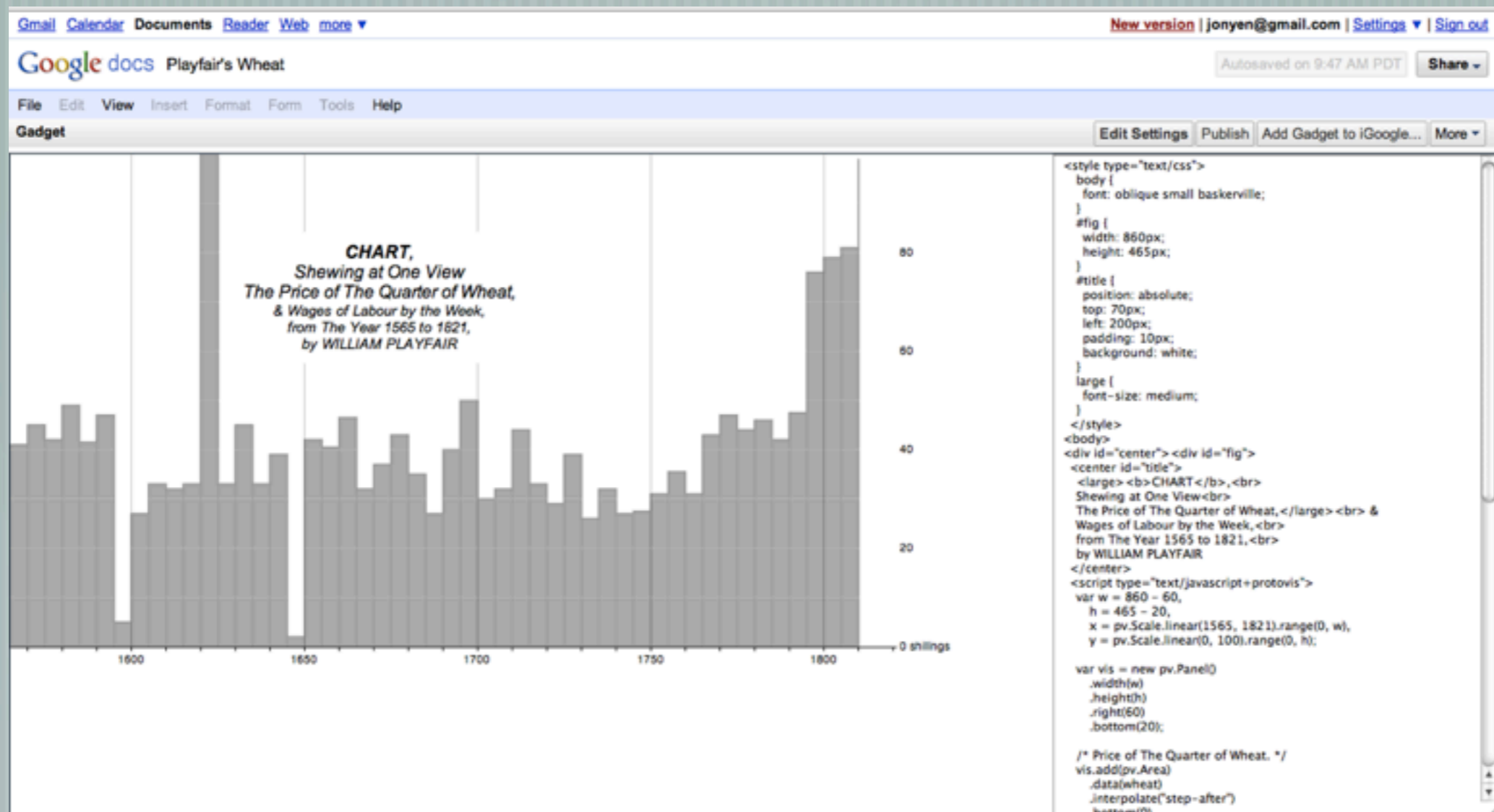
	A	B	C	D	E	F	G	H	I	J	K
1		1850	1860	1870	1880	1900	1910	1920	1930	1940	
2	Accountant / Auditor	708	1805	1310	2295	11753	0	111209	181482	0	30
3	Actor	506	401	1507	3983	10449	15867	14020	28815	12428	1
4	Advertising Agent	0	0	703	499	4526	0	15437	37913	33554	2
5	Agent	2528	4610	5930	20657	19299	52647	30365	54081	92566	11
6	Apprentice	3134	22765	24010	20449	17486	70527	17761	17699	39638	3
7	Apprentice - Auto Mechanic	0	0	0	0	0	0	3532	506	0	
8	Apprentice - Bricklayer	0	1204	3320	899	1004	0	101	2021	0	
9	Apprentice - Carpenter	404	6818	8443	5589	3113	0	1615	2527	13667	1
10	Apprentice - Construction	202	3408	5525	1995	2012	21412	705	1515	18051	
11	Apprentice - Electrician	0	0	0	0	1407	0	4439	1517	7102	1
12	Apprentice - Machinist	0	2612	3212	4391	12049	0	17659	7077	17891	1
13	Apprentice - Mechanic	0	1003	1710	0	504	0	1313	1011	0	
14	Apprentice - Metal Working	0	13251	15780	8480	8337	0	8076	6067	0	
15	Apprentice - Plumber	0	1004	2011	1694	2815	0	5749	6571	8921	1
16	Apprentice - Printing	0	2005	4522	2597	4229	0	5150	9605	15899	2
17	Architect	405	1707	1914	3892	10151	18624	15439	18200	19929	2
18	Artist / Art Teacher	2123	5024	3716	5485	15074	20151	20083	34876	43200	5
19	Athlete	204	100	201	498	3417	0	3735	7579	10153	
20	Auctioneer	809	1908	2108	2594	2818	2519	5652	5053	5580	1
21	Author	101	301	303	797	803	1260	3836	7581	11522	
22	Baggageman	809	1509	2913	5186	7529	12846	11103	7582	5504	
23	Baker	14557	17661	24323	36718	70477	69276	99297	123866	139541	11

The code editor on the left shows the following JavaScript code:

```
var years = [1850,1860,1870,1880,1900,1910,1920,1930,1940,1950,1960,1970,1980,1990,2000];
var jobs = {
  "Accountant / Auditor": {
    men: [708,1805,1310,2295,11753,0,111209,181482,0,330352,425002,575667,661606,814842,866460],
    women: [0,0,0,0,807,0,15746,14657,0,56117,112853,248441,452783,949683,1217596]
  },
  "Actor": {
    men: [506,401,1507,3983,10449,15867,14020,28815,12428,10678,10441,11726,0,0,29975],
    women: [0,100,200,1994,6736,14106,11001,19210,8750,7067,8069,11127,0,0,25931]
  },
  "Advertising Agent": {
    men: [0,0,703,499,4526,0,15437,37913,33554,26603,32275,53993,72865,94797,114250],
    women: [0,0,0,0,0,0,1414,4043,4883,4219,8669,19544,58594,104742,132581]
  },
  "Agent": {
    men: [2528,4610,5930,20657,19299,52647,30365,54081,92566,115523,146745,23236,0,0,0],
    women: [0,200,0,498,906,2016,3632,5562,12692,23172,46524,1102,0,0,0]
  },
  "Apprentice": {
    men: [3134,22765,24010,20449,17486,70527,17761,17699,39638,30590,21110,16425,4442,1865,0],
    women: [101,1107,4116,5585,5026,8548,3428,1517,3091,1072,2492,1103,1622,405,0]
  },
  "Apprentice - Auto Mechanic": {
    men: [0,0,0,0,0,0,3532,506,0,5955,2093,4106,3961,1800,0],
    women: [0,0,0,0,0,0,0,506,0,1074,0,100,120,51,0]
  },
  "Apprentice - Bricklayer": {
    men: [0,1204,3320,899,1004,0,101,2021,0,8290,2991,4710,3562,976,0],
    women: [0,0,0,0,0,0,0,0,0,0,200,140,53,0]
  },
  "Apprentice - Carpenter": {
    men: [404,6818,8443,5589,3113,0,1615,2527,13667,11840,7666,9616,11127,5609,0],
    women: [0,0,101,0,0,0,0,0,1010,54,0,0,840,318,0]
  },
  "Apprentice - Construction": {
    men: [202,3408,5525,1995,2012,21412,705,1515,18051,5717,3489,2603,0,0,0],
    women: [0,202,101,0,0,0,0,0,101,0,100,302,0,0,0]
  },
  "Apprentice - Electrician": {
    men: [0,0,0,0,1407,0,4439,1517,7102,12387,9156,22140,18589,17188,0],
    women: [0,0,0,0,0,0,0,0,101,0,99,500,1160,901,0]
  },
  "Apprentice - Machinist": {
    men: [0,2612,3212,4391,12049,0,17659,7077,17891,17372,14067,17724,15146,4030,0],
    women: [0,0,0,200,100,0,101,0,0,165,497,401,841,356,0]
  },
  "Apprentice - Mechanic": {
    men: [0,1003,1710,1011,1011,0,4726,4784,5309,0,0,0],
    women: [0,0,101,0,0,0,0,0,0,0,200,201,0,0,0]
  }
}
```

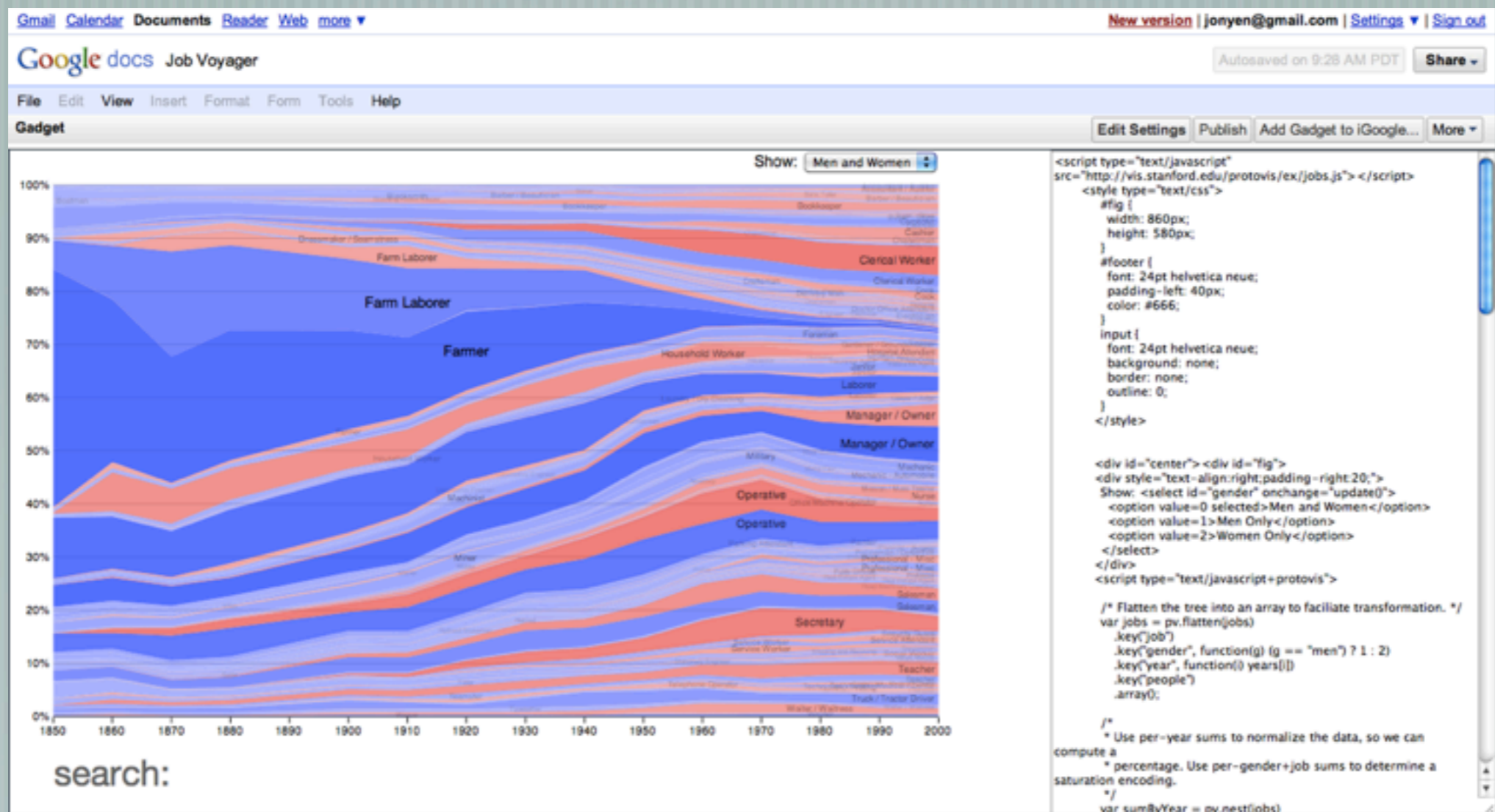
# Implementation

## UI for Viewing and Editing Visualization



# Implementation

## UI for Viewing and Editing Visualization





# Results

— [ Converted a corpus of Protovis example data into Google Spreadsheet implementations

— [ Able to modify both the data and the source code for the visualization dynamically

— [ Use of our implementation is roughly equivalent to that of other tools available, but also more customizable

# Discussion / Future Work

## ProtoDocs

- Useful in collaboration process for creating visualizations
- Allows for use in conjunction with existing information visualization tools

## Future work

- Investigate use with other toolkits (i.e., The JavaScript InfoVis Toolkit, flare)
- Refine UI and explore direct manipulation