STATISTICS IN THE CLASSROOM

on Touch-based Smart Phones

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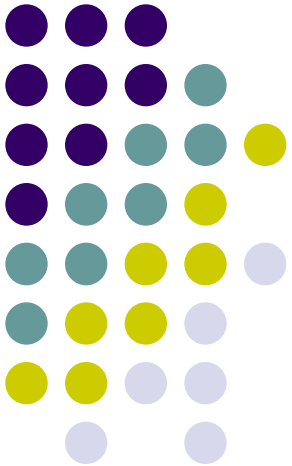

Pew Research - News Flash 3/13/2013

- 78% percent of Americans aged 12 to 17 have cell phones
- 37% have smart phones (up from 23% in 2011)

- 75% access Internet on mobile devices (smart phone, tablet)
- 25% go online *mostly* by phone not computer (vs 15% adults)

http://pewinternet.org/Reports/2013/Teens-and-Tech.aspx

- > 80% of College students have smart phones
- Modern cell phone:1.7 GHz quad-core CPU with 2GB RAM

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HOW ARE WE UTILIZING THIS COMPUTING POWER?

Seton Hall University
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South Orange, NJ 07079
(973) 761-9000

Campus Map
Visiting Campus

Links and Resources

News and Events
Parents and Families
Career Center
Employment
Public Safety
Accountability

Information Technology
Questions and Comments

SHUmobile

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Statistics

- … the science of making sense of data …
- Statistics with **real** data is ***real*** fun

  - *Compare mean versus median for the data 1,3,5,4,2,1,4,3,2,1,6,3,100. Explain*

  or

  - *Compare mean versus median for Major League Baseball salaries in 2011. Explain*

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Statistics with Real Data

- *Real data* requires **computational tools**
  - *There were over 800 MLB players in 2011*
- **Computational tools** require
  - Hardware
  - Software
  - Resources
  - Infrastructure (campus WIFI)

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Computational Tools

- Calculator
  - *Not sophisticated enough*
- Statistics Calculator
  - *Too hard to enter large data sets*
- SPSS (or similar software)
  - *Requires computer*
  - *Installation*
  - *Learning curve*
  - *Licensing costs*

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StatCrunch vs SPSS

SPSS (or similar)

- *Requires computer*
- *Requires Installation*
- *Steep Learning curve*
- *Licensing costs*

StatCrunch

- *Requires computer*
- ~~*Requires Installation*~~
- ~~*Steep*~~ *Learning curve*
- ~~*Licensing costs*~~

... assuming both are suitable for the task of supporting statistical calculations in an introductory statistics class ...

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StatCrunch vs StatCrunch Mobile

SPSS (or similar)

- *Requires computer*
- *Requires Installation*
- *Steep Learning curve*
- *Licensing costs*

StatCrunch

- *Requires computer*
- ~~*Requires Installation*~~
- ~~*Steep* Learning curve~~
- ~~*Licensing costs*~~

StatCrunch Mobile

- ~~*Requires computer*~~
- ~~*Requires Installation*~~
- ~~*Steep Learning curve*~~
- ~~*Licensing costs*~~

… assuming all three are suitable for the task of supporting statistical calculations in an introductory statistics class …

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StatCrunch Mobile

- Runs on any mobile device with an HTML5-compatible browser (iPhone, Android, Windows Phone)
- Offers a well-chosen subset of options from regular StatCrunch
- Included in standard StatCrunch license cost, frequently bundled with text book
- Optimized to run on small screen without physical keyboard
- Optimized for touch interface

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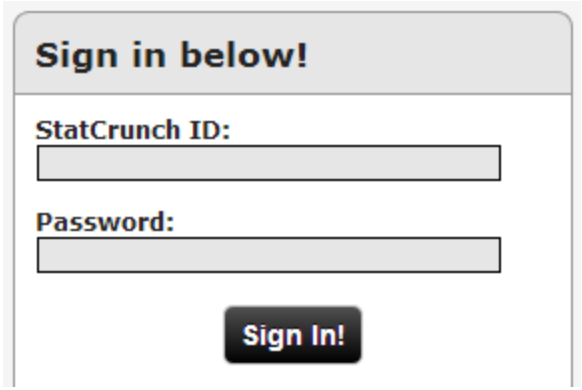
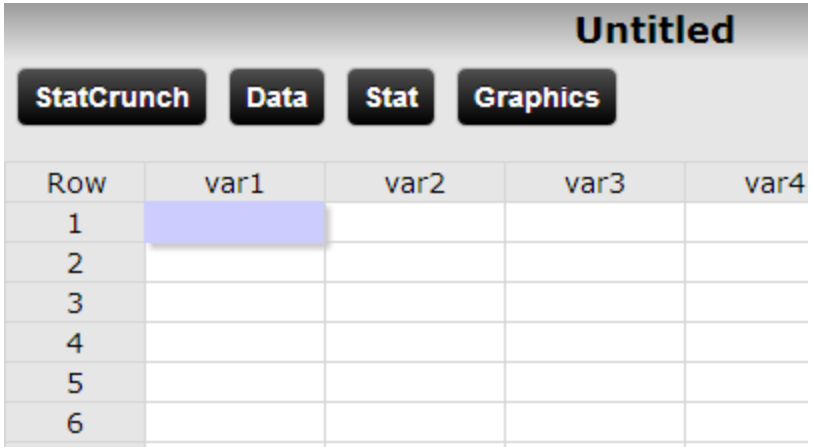
Example

Task: *Compute average and median salary for 2011 MLB players.*

Visit www.statcrunch.com/mobile and login:





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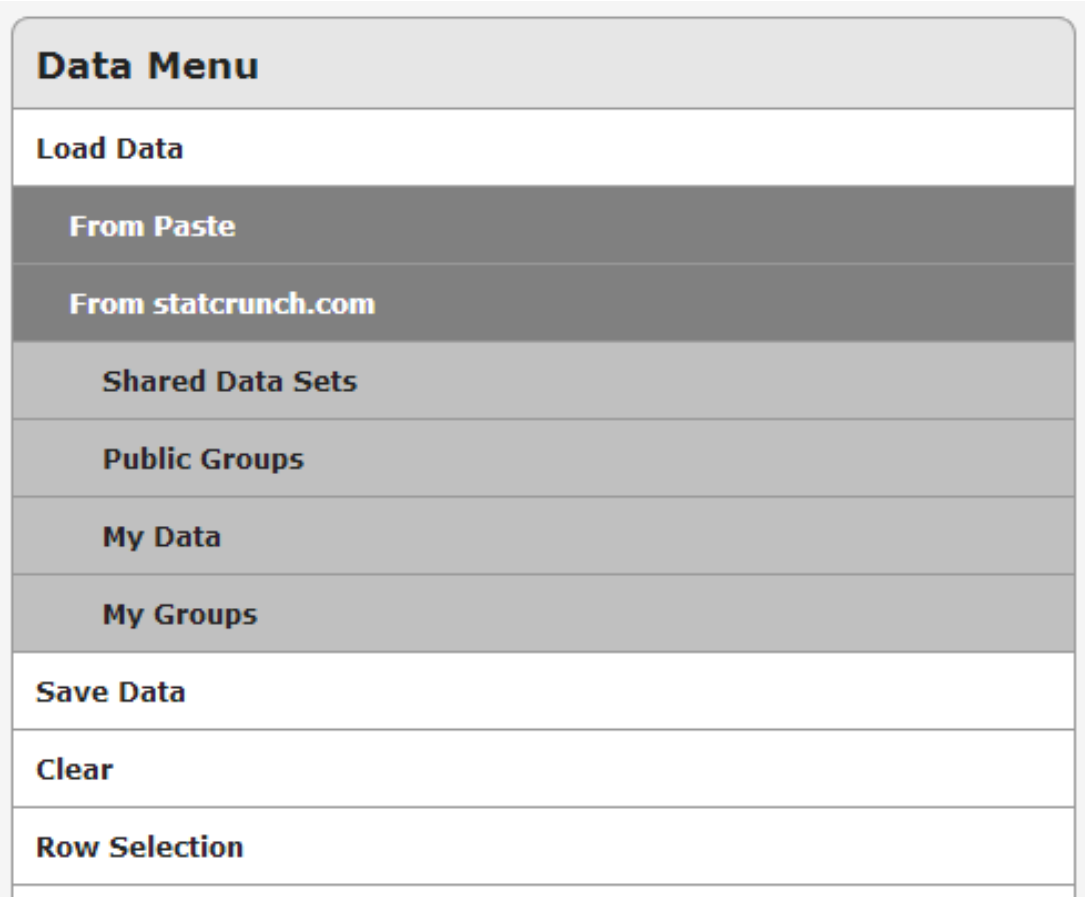
Loading Data

- can load same “My Data” loaded into regular StatCrunch
- can load “Shared Data Sets”
- *can **not** load data from the web or from the local device*



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Computing Summary Stats

MLBPlayerSalaries.xlsx

StatCrunch | Data | Stat | Graphics

Row	Year	Player	Salary	Positio
1	1988	Mike Witt	1400000	Pitch
2	1988	George Hen	989333	Outfiel
3	1988	Chili Davis	950000	Outfiel

Stat Menu

- Summary Stats
  - Columns
  - Rows

Summary Stats

Select Column(s):
Year
Salary

Where:
--optional-- Build

Group by:
--optional--

Statistics:
n
Mean

Summary statistics:

Column	n	Mean	Variance	Std. Dev.	Std. Err.	Median
Salary	19543	1916817	9.0368888e12	3006141.8	21503.733	565000

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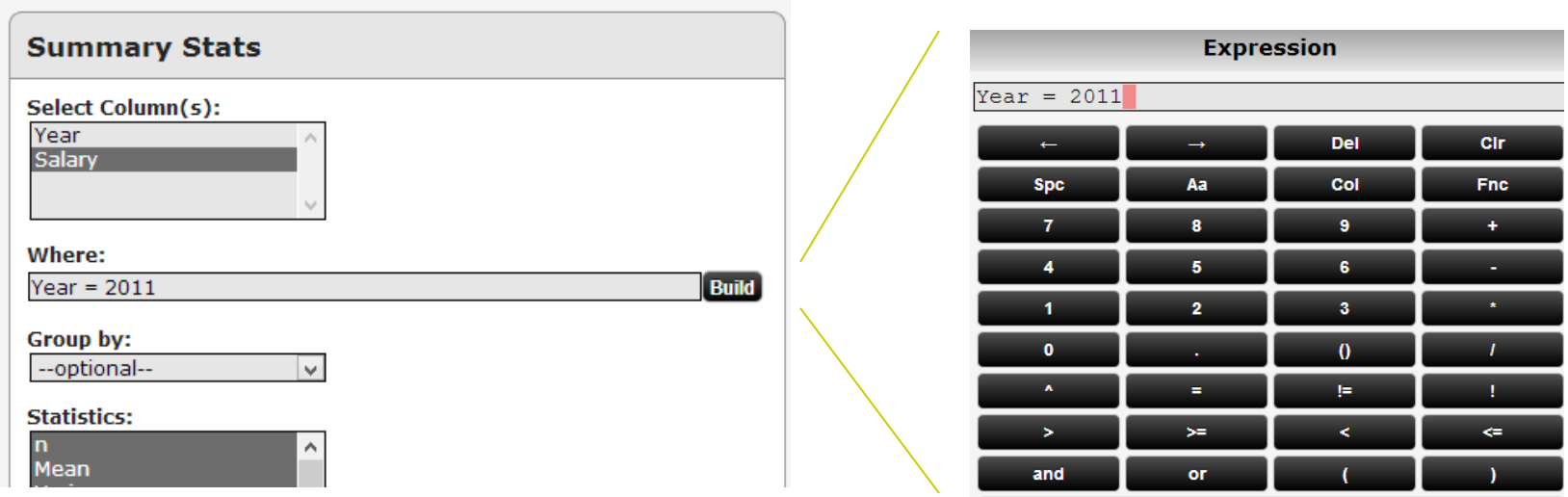
Selecting the Right Data

- Average salary: $1,916,817
  Median salary: $565,000

MLBPlayerSalaries.

StatCrunch | Data | Stat | Graphi

Row	Year	Player	S
1	1988	Mike Witt	1
2	1988	George Hen(	
3	1988	Chili Davis	



- Average salary **2011**: **$3,305,054**
  Median salary **2011**: **$1,175,000**

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StatCrunch Mobile Project

- 27 UG Students with a variety of background in Fall 2012
- Students received Nokia 900 phones (Windows Phone 7.5) and used StatCrunch mobile as part of a TLTC grant

=> **Treatment**

- 28 UG students with similar background in Spring 2012
- Students used ‘regular’ StatCrunch

=> Control

- Same textbook, similar material, similar lecture notes, similar assignments, but “treatment” used StatCrunch (mobile) virtually every class, “control” mainly for HW

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Two-Sample Difference of Means (*)

Hypothesis test results:

μ_1 : Mean of Spring

μ_2 : Mean of Fall

$\mu_1 - \mu_2$: Difference between two means

$H_0 : \mu_1 - \mu_2 = 0$

$H_A : \mu_1 - \mu_2 < 0$

(with pooled variances)

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	-8.3988324	5.1910779	53	-1.6179361	0.0558

(*) includes *all* grades, including 3 students who did not properly finish the course

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Two-Sample Difference of Means(**)

Hypothesis test results:

μ_1 : Mean of Spring (adj)

μ_2 : Mean of Fall (adj)

$\mu_1 - \mu_2$: Difference between two means

$H_0 : \mu_1 - \mu_2 = 0$

$H_A : \mu_1 - \mu_2 < 0$

(with pooled variances)

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	-4.0117823	3.0629076	50	-1.3097954	0.0981

(**) include all but three (lowest) grades (3 students did not finish the course)

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Typical Questions

- Does attending college pay off? Specifically, is there a relation between the highest degree of education and the income level in the US?
- Is there a relation between "average life expectancy" and "literacy rate" in various countries? If so, could you predict the life expectancy in a country based on its literacy rate? Does that imply that reading more makes you live longer?
- Conventional wisdom has it that the normal temperature of a person is 98.6^{o} F. Is that true? Do men and women have different body temperatures? Is there a relation between temperature and heart beat at rest?

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Survey

- Administered survey to measure student satisfaction (treatment only)

- 24 students responded (89%)

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Survey Results

1. Do you have your own smart phone?

	N	*Percent*	*Valid Percent*
No	2	8.3%	8.3%
Android	4	16.7%	16.7%
iOS	17	70.8%	70.8%
Win Phone	0	0.0%	0.0%
Blackberry	1	4.2%	4.2%
Other	0	0.0%	0.0%
Missing	*0*	*0.0%*	

2. Which device did you prefer for StatCrunch mobile

	N	*Percent*	*Valid Percent*
My own device	4	16.7%	17.4%
SHU Nokia 900	19	79.2%	82.6%
Missing	*1*	*4.2%*	

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Survey Results

3. Have you used StatCrunch mobile on your preferred mobile device?

	(1.0) *a lot*	(2.0) *sometimes*	(3.0) *a little*	(4.0) *not at all*	**Avg**	**Std Dev**	*Missing*
How often did you use it for homework	75.0% 18	12.5% 3	4.2% 1	8.3% 2	**1.4583**	**0.9315**	*0.0% 0.0*
How often did you use it in class	87.0% 20	4.3% 1	0.0% 0	8.7% 2	**1.3043**	**0.8757**	*4.2% 1.0*

Percentages in the table are valid percent.

4. Have you used the full version of StatCrunch on your laptop?

	(1.0) *a lot*	(2.0) *sometimes*	(3.0) *a little*	(4.0) *not at all*	**Avg**	**Std Dev**	*Missing*
How often did you use it for homework	4.2% 1	29.2% 7	45.8% 11	20.8% 5	**2.8333**	**0.8165**	*0.0% 0.0*
How often did you use it in class	8.3% 2	25.0% 6	29.2% 7	37.5% 9	**2.9583**	**0.9991**	*0.0% 0.0*

Percentages in the table are valid percent.

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Survey Results

6. Was StatCrunch mobile helpful for understanding statistical concepts introduced in class? (circle one)

	N	*Percent*	*Valid Percent*
very helpful	20	83.3%	87.0%
somewhat helpful	2	8.3%	8.7%
somewhat unhelpful	1	4.2%	4.3%
very unhelpful	0	0.0%	0.0%
Missing	*1*	*4.2%*	

7. Did you learn more about Statistics using StatCrunch mobile or less?

	N	*Percent*	*Valid Percent*
learned more	19	79.2%	82.6%
about the same	4	16.7%	17.4%
learned less	0	0.0%	0.0%
Missing	*1*	*4.2%*	

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Survey Results

5. How easy or hard was it to use StatCrunch mobile on your preferred mobile device? (circle one)

	N	*Percent*	*Valid Percent*
very easy	15	62.5%	65.2%
somewhat easy	7	29.2%	30.4%
somewhat hard	0	0.0%	0.0%
very hard	1	4.2%	4.3%

8. Did StatCrunch Mobile make this class easier or harder?

	N	*Percent*	*Valid Percent*
easier	23	95.8%	100.0%
about the same	0	0.0%	0.0%
harder	0	0.0%	0.0%
Missing	*1*	*4.2%*	

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Survey Results

9. Did you prefer using StatCrunch mobile on a phone or the full version of StatCrunch on a laptop?

	N	*Percent*	*Valid Percent*
mobile version	20	83.3%	87.0%
no real preference	3	12.5%	13.0%
laptop version	0	0.0%	0.0%
Missing	*1*	*4.2%*	

12. If you had to take the class again and you had a choice, would you:

	N	*Percent*	*Valid Percent*
prefer a stats class without specialized software	0	0.0%	0.0%
prefer a stats class with special software on a laptop	1	4.2%	4.5%
prefer a stats class with special software on a mobile device	21	87.5%	95.5%
Missing	*2*	*8.3%*	

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Survey Results

15. How did you like the Windows Phone System, particularly:

	(1.0) *a lot*	(2.0) *Somewhat*	(3.0) *A little*	(4.0) *Not at all*	**Avg**	**Std Dev**	*Missing*
Ease of use	21.1% 4	52.6% 10	15.8% 3	10.5% 2	**2.1579**	**0.8983**	*20.8% 5.0*
Functionality	26.3% 5	52.6% 10	10.5% 2	10.5% 2	**2.0526**	**0.9113**	*20.8% 5.0*
Organization	26.3% 5	42.1% 8	15.8% 3	15.8% 3	**2.2105**	**1.0317**	*20.8% 5.0*
Look and feel	31.6% 6	47.4% 9	10.5% 2	10.5% 2	**2.0000**	**0.9428**	*20.8% 5.0*
Usefulness	47.4% 9	31.6% 6	10.5% 2	10.5% 2	**1.8421**	**1.0145**	*20.8% 5.0*
Included apps	31.6% 6	36.8% 7	15.8% 3	15.8% 3	**2.1579**	**1.0679**	*20.8% 5.0*
Downloadable apps	27.8% 5	33.3% 6	22.2% 4	16.7% 3	**2.2778**	**1.0741**	*25.0% 6.0*

Percentages in the table are valid percent.

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Survey Results

17. If you could get any smart phone you wanted, no strings attached, what would you get:

	N	*Percent*	*Valid Percent*
Android	3	12.5%	15.0%
iOS	16	66.7%	80.0%
Win Phone	1	4.2%	5.0%
Blackberry	0	0.0%	0.0%
Other	0	0.0%	0.0%
Missing	*4*	*16.7%*	

1. Do you have your own smart phone?

	N	*Percent*	*Valid Percent*
No	2	8.3%	8.3%
Android	4	16.7%	16.7%
iOS	17	70.8%	70.8%
Win Phone	0	0.0%	0.0%
Blackberry	1	4.2%	4.2%
Other	0	0.0%	0.0%
Missing	*0*	*0.0%*	

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Survey Results

10. What is the best feature of StatCrunch mobile? [text response]

- *accessibility through the phone*
- *does the math for you instead of memorizing all the formulas*
- *easier & more convenient*
- *helped me to understand almost everything*
- *it is a quick and accurate way to find out data and reach a conclusion*
- *it is easy to switch back and forth to the calculator*
- *the effectiveness of saving time by doing calculations*
- *[…]*

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Survey Results

11. What did you like least about StatCrunch mobile? [text response]

- *nothing*
- *didn´t let you scroll through the data set*
- *hard to understand at first*
- *how it wasn´t necessary for me to memorize formulas and learn them because StatCrunch did everything for me.*
- *it is tedious putting the #´s in*
- *in the laptop you can view more #s at once but that´s it, no qualms about mobile*
- *when you press the ¨Back¨ button you have to sign in again*
- *[…]*

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Advantages of Smart Phones

- Touch screen
- Ease of use
- Familiarity
- Fixability
- Portability
- Connectedness (important if no campus Wifi)
- No learning curve (for students)
- No running out of battery

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Disadvantages of StatCrunch mobile

- Can not print
- Can not copy-paste
- Possibility to cheat

- Steep learning curve
  (for Instructors :-)

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Discussion

- StatCrunch mobile clearly preferred by students
- Treatment group performed better than Control
  - Small sample only
  - No direct comparison within one semester
  - Getting a new smart phone might have made students more willing to experiment

  Or

  - Mobile apps have inherent advantages based on the easy to use touch interface and their ubiquity

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Future Work

- Compare StatCrunch vs Mobile in a larger study with groups in the same semester
- Study other smart phone apps, such as Wolfram Alpha (for mobile)
- *Study the acceptance of faculty to smart phone based apps*

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