From 100 Students to 100,000

Jennifer Widom
Stanford University
“Introduction to Databases”

**CS145 @ Stanford**

140  (enrolled students)

**DB-Class @ world**

60,000  (enrolled students)

26,000  (of them submitted 1+ assignments)

6,500  (completed the entire course)

**DB-Class cumulative**  [April ‘12]

108,000  (accounts)

475,000  (assignment submissions)

3,150,000  (video views)
History

1) “Flipped classroom”
2) Complete course materials online
3) Public course offering
“Flipped Classroom”

Lectures ➔ self-paced videos with embedded quizzes

Class time ➔ interactive activities
Isolation Level **Read Committed**

- A transaction may **not** perform dirty reads
- Still does not guarantee global serializability

```
Update Student Set GPA = (1.1) * GPA Where sizeHS > 2500
```

 concurrent with ...

```
Set Transaction Isolation Level Read Committed;
Select Avg(GPA) From Student;
Select Max(GPA) From Student;
```

\[ T_1 \cap T_2 \quad T_2 \cap T_1 \]
Sample Video (demo)

```
select Student.sID, count(district cName)
from Student, Apply
where Student.sID = Apply.sID
group by Student.sID
union
select sID, 0
from Student
where sID not in (select sID from Apply);
```
Sample In-Video Quiz

Consider a relation $R(A,B,C)$ with multivalued dependency $A \rightarrow B$. Suppose there at least 3 different values for $A$, and each value of $A$ is associated with at least 4 different $B$ values and at least 5 different $C$ values.

What is the minimum number of tuples in $R$?

- 60
- 15
- 12
- 27
Consider a relation $R(A,B,C)$ with multivalued dependency $A \rightarrow B$. Suppose there at least 3 different values for $A$, and each value of $A$ is associated with at least 4 different $B$ values and at least 5 different $C$ values.

What is the correct option?

- 6
- 12
- 27

**Correct**
Classroom Time

• Professor-led interactive problem-solving

• Lectures outside of core material
  – Guest lectures from industry
  – Guest lectures from Stanford
  – Research presentations
  – Advanced/exotic topics

• Help/review sessions
Step #2: Course Materials Publicly Available

Videos with embedded quizzes
+ Comprehensive exercises
+ Slides, scripts, readings, software guides

= Complete course

- Completed summer 2011
- 1000’s of views
The Inflection Point

Online materials ➔ Structured course offering

- Schedule
- Automated exercises
- Online exams
- "Statement of accomplishment"
- Community (Still free of charge)

- Transformed 1000’s to 10,000’s
- Three courses in Fall 2011
  - Artificial Intelligence
  - Machine Learning
  - Introduction to Databases
Automated Exercises

• Quizzes using technology from Gradiance
  – “Root” question + bank of correct & incorrect answers
  – Explanations
  – Different for each student

• Automatically-checked programming exercises
  – Particularly well-suited for database class
  – Relational algebra, SQL, triggers, views, DTDs, XPath & XQuery, XSLT

Students encouraged to repeat until perfect score
Authorization Quiz

This quiz uses an approach pioneered and patented by the Gradiance Corporation. Each multiple-choice quiz problem is based on a "root question," from which the system generates different correct and incorrect choices each time you take the quiz. Thus, you can test yourself on the same material multiple times. We strongly urge you to continue testing on each topic until you complete the quiz with a perfect score at least once.

After submitting your selections the system will score your quiz, and for incorrect answers will provide an "explanation" (sometimes for correct ones too). These explanations should help you get the right answer the next time around. To prevent rapid-fire guessing, the system enforces a minimum of 10 minutes between each submission of solutions.

Question 1
Unanswered

Consider a set of users U, V, W, X, and Y. Suppose user U creates a table T and thus is the owner of T. Now suppose the following set of statements is executed in order:

1. User U: grant select on T to V,W with grant option
2. User V: grant select on T to W
3. User W: grant select on T to X,Y
4. User U: grant select on T to X
5. User U: revoke select on T from V restrict
6. User U: revoke select on T from W cascade

Which of the following statements is true?

- Y does not have privilege SELECT ON T after statement 6
- W does not have privilege SELECT ON T after statement 5
- X does not have privilege SELECT ON T after statement 5
- X does not have privilege SELECT ON T after statement 6

Question 2
Unanswered

The following SQL statement over tables R(c,d), S(f,g), and T(a,b) requires certain privileges to execute:

```sql
UPDATE T
SET a=1, b=2
WHERE a <= ALL (SELECT d FROM R)
OR EXISTS (SELECT f FROM S WHERE f > T.a)
```

Which of the following privileges is not useful for execution of this SQL statement?

- SELECT ON T(b)
- SELECT ON R(a)
XML Course-Catalog XPath and XQuery Exercises

In these exercises, you will be working with a small XML data set drawn from the Stanford course catalog. There are multiple departments, each with a department chair, some courses, and professors and/or lecturers who teach courses. The XML data is here.

Instructions: You are to write each of the following queries using either XPath or XQuery. Each question contains a link to a Query Workbench. The workbench will help you develop and debug your queries by running them using Saxon over the sample data set. Once you’re satisfied with your solution, click the "Keep This Solution" button in the Query Workbench — your query will be copied automatically to the box on this page for final submission.

You may perform these exercises as many times as you like, so we strongly encourage you to keep working with them until you complete the exercises with full credit.

NOTE: REMEMBER TO CLICK "Save and Submit" WHEN YOU ARE DONE!
Please be patient as it does take time to check all of the exercises.

Question 1
Unanswered

Return all Title elements (of both departments and courses).
Note: Your solution will need to reference doc("courses.xml") to access the data.

Query Workbench

Question 2
Unanswered

Return last names of all department chairs.
Note: Your solution will need to reference doc("courses.xml") to access the data.

Query Workbench
Personal Touch
Need for Perfection

Each order of magnitude more students

⇒ order of magnitude higher need to avoid ambiguities and errors
Meanwhile Back at Stanford

- Automated exercises and level of perfection well appreciated

Q: “Added value” for tuition?
- In-class activities and lectures
- Hand-graded written exercises
- Programming project
- Real exams

Statistically-significant increase in evaluations
The Public Students

Deeply appreciative

With deepest feelings, thanks a lot, Professor Widom A20 all the db-class team! You’ve made wonderful things come true! Teaching could not be just a profession, but an Art - and that’s what you did! That’s an honour for me, to be in this class. Whatever happens with me later on - but these times I will never forget. Happy New Year 2012 for everybody here!

Posted by: Anaxandira Kimchiua (+15) [Edit] [Delete] 3 months 4 weeks ago [Follow?]

Like others I am very grateful for the time and hard work that Professor Widom and her team creating the website have put into this course.
The assignment and quiz system motivated me to learn the materials and the screencast chats kept that momentum to continue.
The many helpful questions and answers on this forum have really assisted when I had problems.
Good luck with the final exam everyone.

-Marius

Posted by: Marcus Baghavan (+29) [Edit] [Delete] 3 months 12 hours ago [Follow?]

Hello everyone,

Prof Widom is great and I had very good time! Hope everyone is listening to her lectures and doing the assignments for the past few months. I could not really take the point that the course is ending soon. Thanks Prof Widom! I admire you.

Anonymous User

Posted by: Anonymous User [Edit] [Delete] 4 months 16 hours ago [Follow?]

Thanks to Prof. Widom and all the db-class staff for this high-quality course! I have learnt a lot about databases and now I’m more confident to undertake this kind of tasks in a future. Most important, thanks for all the personal effort that you have put on this online course to humanize what could have been a cold weekly experience in front of a machine. You and the other students in Q&A forum have made this experience more like a real class than by using other platforms such as MOOC's. I recommend this course to all students interested in the database scientific area.

I hope to meet again with all of you in future courses.

Juan Luis Herrera Cortes (+49) [Edit] [Delete] 3 months 4 weeks ago [Follow?]

Many thanks to you, Prof. Widom!

Posted by: Andrey Shapawat (+19) [Edit] [Delete] 4 months 8 hours ago [Follow?]

Thanks Professor Widom. You are now one of my teachers that I will remember for ever and ever. One of the best organized course I have ever taken. You rock!!

Posted by: Shridha Sajijantra (+20) [Edit] [Delete] 4 months 3 weeks ago [Follow?]
A Top Student

• Posted 900 answers on Q&A Forum
• No discrimination against “dumb” questions
• Each answer correct, of perfect length, with examples when appropriate, perfect English
A Top Student

Q&A Forum - View

Mary Cunningham

108
Now that the course is approaching its end, I would like to express my gratitude towards Amy Cunningham for her great contribution to this forum. Her clear and constructive answers helped us a lot in understanding the materials and exercises. Amy, thank you very much!

Posted by Anonymous User [Edit] [Delete] 4 months 10 hours ago [Feature?]

Sort By Relevance | Date (Newest First) | Date (Oldest First) Page 1 of 2 >>

54
I'm waiting for someone to propose marriage to her. :)<DownOnHisKnees>

Amy, I have little to offer but a very large collection of dried, prepared and mounted plant and flower specimens on standard botanical specimen cards. It's quite an extensive collection, though. In addition to that I have several computers all with different operating systems and I also have access to some restricted databases. I have a house, car and stable job. I am also a very good cook. Other domestic attributes that I possess include keeping things tidy, and covering reference books I buy with removable plastic (not that self-adhesive stuff that is impossible to remove if it becomes damaged). I have over 200 books and it's possible I will let you read some of them. I get up early and go to bed early (well, most of the time). Based on this, I humbly ask: are you single?<DownOnHisKnees>

Edit: Oh I also like to cook computer games, C, C++, SQL, Python, PHP, Modula-2, Lisp and occasionally ASM. I don't particularly like Javascript or even HTML. COBOL I can deal with, but prefer not to.

Edit: Oh and also I probably should have given you a FLOW.

Posted by: Craig Robbins (+346) [Edit] [Delete] 4 months 8 hours ago [Feature?]

36
I sometimes think Amy is Prof Widom in disguise!! An under-cover agent!

Posted by: Veena H Bhat (+104) [Edit] [Delete] 3 months 4 weeks ago [Feature?]

15
Amy you are brilliant. You always provide precise explanation of every question. Whenever I stuck I start looking for answers posted by Amy Cunningham. Thanks Amy

Posted by: Anonymous User [Edit] [Delete] 4 months 7 hours ago [Feature?]

14
@Amy, thanks for all the great answers.

Posted by: Robert Oregio (+28) [Edit] [Delete] 3 months 4 weeks ago [Feature?]
Downsides

1) Complainers
2) Cheaters
What’s Next

• ~10 additional Stanford courses launching
  Mostly CS, but some others

• Very high interest across campus and beyond

• “Competitive” efforts
  Universities and Companies
Big Questions (selected subset!)

❖ Course-content ownership – university or professor?
❖ Teaching credit for putting courses online? Money?
❖ Who’s responsible for course production? Hosting?
❖ Is it a university’s mission to educate the world?
❖ If everything is online, what’s the $50K/year buying?
❖ What’s the future of higher education?
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