

Visualizations for Introducing Database Concepts in Forensic Science



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Purpose

Introducing database concepts and development through visualization has demonstrated to be a successful pedagogical method for understanding this concept.¹

Using animations available at the project Web-site², volunteer faculty created animations that were customized to their particular discipline, including forensic science.

By understanding how a database operates, the user may be able to better utilize the power databases have. The advantage of the database is that, while one copy of the data exists, it also provides a powerful tool to ask different questions, or queries, of that data without changing the data.

Introduction to Databases

The volunteer also needed to identify critical information that would play an important role in the customization and ultimate successful demonstration of the customized animations. These elements included the identification of the primary key in each table and the foreign key.

Customization: Primary Key Left Button Table

The attribute called InmateNumber in the Inmates table is a primary key because it uniquely identifies an inmate in the database.

Name	InmateNumber	Gender	InmateStatus
Smith, Matthew	123456789	male	inactive
Smith, M	345678901	female	parole
Perry, L	456789012	female	active
Lane, P	567890123	female	active
MacMurray, Fred	678901234	male	active
Spoth, A	901234567	female	inactive
Grissom, Gus	112345678	male	active
Grissom, Gus	113467890	male	active

Customization: Foreign Key Referencing Left Button Table

InmateNumber is a foreign key in the InmateCases table, since it references the primary key InmateNumber in the Inmates table.

Name	InmateNumber	Gender	InmateStatus
Smith, Matthew	123456789	male	inactive
Smith, M	345678901	female	parole
Perry, L	456789012	female	active
Lane, P	567890123	female	active
MacMurray, Fred	678901234	male	active
Spoth, A	901234567	female	inactive
Grissom, Gus	112345678	male	active
Grissom, Gus	113467890	male	active

InmateNumber	CaseNumber	CaseStatus
123456789	2003998324	Acquittal
123456789	2013998967	Acquittal
123456789	2013998967	Acquittal
345678901	2012369584	Convicted
456789012	2013998758	Convicted
567890123	2013998967	Pending
678901234	2014000023	Convicted
901234567	2015998753	Convicted
112345678	1998024567	Acquittal
113467890	2011888759	Convicted
113467890	2016000056	Pending
113467890	2003998745	Convicted

Select a key to review

Name	InmateNumber	Gender	InmateStatus
Smith, Matthew	123456789	male	inactive
Smith, M	345678901	female	parole
Perry, L	456789012	female	active
Lane, P	567890123	female	active
MacMurray, Fred	678901234	male	active
Spoth, A	901234567	female	inactive
Grissom, Gus	112345678	male	active
Grissom, Gus	113467890	male	active

InmateNumber	CaseNumber	CaseStatus
123456789	2003998324	Acquittal
123456789	2013998967	Acquittal
123456789	2013998967	Acquittal
345678901	2012369584	Convicted
456789012	2013998758	Convicted
567890123	2013998967	Pending
678901234	2014000023	Convicted
901234567	2015998753	Convicted
112345678	1998024567	Acquittal
113467890	2011888759	Convicted
113467890	2016000056	Pending
113467890	2003998745	Convicted

CaseNumber	OffenseDate	Offense
2003998324	2003-11-06	homicide
2013998967	2013-12-12	assault
2012369584	2012-05-30	assault
2013998758	2013-12-12	burglary
2014000023	2014-01-01	assault
2015998753	2015-12-05	assault
2003998745	2003-11-05	homicide
1998024567	1998-02-14	homicide
2011888759	2011-11-05	assault
2016000056	2016-01-15	homicide

Self-Assessment Checkpoints

Self-assessment checkpoint questions are also customizable for students to check for understanding.

Customization: Click CUSTOMIZE to Revise Choices

In the InmateCases table, InmateNumber is redundant, i.e., unnecessarily repeated.

☐ False ☒ True

The InmateNumber must be repeated for each case number related to the inmate.

Breakdown

Introduction to Querying

Customizable animations for the Introduction to Querying were also produced based on the completed Intro to DB animations.

Customization: Queries Second Step

Using the value of the CaseNumber primary key, 2003998745, the database finds the matching foreign key CaseNumber value, 2003998745, in the InmateCases table.

CaseNumber	OffenseDate	Offense
2003998324	2003-11-06	homicide
2013998967	2013-12-12	assault
2012369584	2012-05-30	assault
2013998758	2013-12-12	burglary
2014000023	2014-01-01	assault
2015998753	2015-12-05	assault
2003998745	2003-11-05	homicide
1998024567	1998-02-14	homicide
2011888759	2011-11-05	assault
2016000056	2016-01-15	homicide

InmateNumber	CaseNumber	CaseStatus
123456789	2003998324	Acquittal
123456789	2013998967	Acquittal
345678901	2012369584	Convicted
456789012	2013998758	Convicted
567890123	2013998967	Pending
678901234	2014000023	Convicted
901234567	2015998753	Convicted
112345678	1998024567	Acquittal
113467890	2011888759	Convicted
113467890	2016000056	Pending
113467890	2003998745	Convicted

Challenges

The key in understanding how to successfully complete the customized animations is understanding how relational databases work.

Issues related to animation customization include:

- User understanding of basic database terms
- Demonstration of database anomalies
- Character size and limits placed in animations

Customization: Delete Anomaly - Click row to highlight

Name	InmateNumber	Gender	InmateStatus	CaseNumber	OffenseDate	Offense	CaseStatus
Smith, Matthew	123456789	male	inactive	2003998324	2003-11-06	homicide	Acquittal
Smith, Matthew	123456789	male	inactive	2013998967	2013-12-12	assault	Acquittal
Smith, M	345678901	female	parole	2012369584	2012-05-30	assault	Convicted
Perry, L	456789012	female	active	2013998758	2013-12-12	burglary	Convicted
Lane, P	567890123	female	active	2013998967	2013-12-12	assault	Pending
MacMurray, Fred	678901234	male	active	2014000023	2014-01-01	assault	Convicted
MacMurray, Fred	678901234	male	active	2015998753	2015-12-05	assault	InTrial
Spoth, A	901234567	female	inactive	2003998745	2003-11-05	homicide	Convicted
Grissom, Gus	112345678	male	active	1998024567	1998-02-14	homicide	Acquittal
Grissom, Gus	113467890	male	active	2011888759	2011-11-05	assault	Convicted
Grissom, Gus	113467890	male	active	2016000056	2016-01-15	homicide	Pending
Grissom, Gus	113467890	male	active	2003998745	2003-11-05	homicide	Convicted

Records for law enforcement and forensic science should not be deleted. If, however, a mistake is made and case 2003998324 against Matthew Smith is dropped by deleting the row (instead of changing the case status to "Dropped"), all information for that case number would be lost.

Save to Memory Save to File Cancel

Customization: Update Anomaly - Click Customize for more options

Name	InmateNumber	Gender	InmateStatus	CaseNumber	OffenseDate	Offense	CaseStatus
Smith, Matthew	123456789	male	inactive	2003998324	2003-11-06	homicide	Acquittal
Smith, Matthew	123456789	male	inactive	2013998967	2013-12-12	assault	Acquittal
Smith, M	345678901	female	parole	2012369584	2012-05-30	assault	Convicted
Perry, L	456789012	female	active	2013998758	2013-12-12	burglary	Convicted
Lane, P	567890123	female	active	2013998967	2013-12-12	assault	Pending
MacMurray, Fred	678901234	male	inactive	2014000023	2014-01-01	assault	Convicted
MacMurray, Fred	678901234	male	inactive	2015998753	2015-12-05	assault	Convicted
Spoth, A	901234567	female	inactive	1998024567	1998-02-14	homicide	Acquittal
Grissom, Gus	112345678	male	active	2011888759	2011-11-05	assault	Convicted
Grissom, Gus	113467890	male	active	2016000056	2016-01-15	homicide	Pending
Grissom, Gus	113467890	male	active	2003998745	2003-11-05	homicide	Convicted

For example, updating inmate status must update all records related to the InmateNumber.

This is called an update anomaly.

Save to Memory Save to File Cancel CUSTOMIZE

Future Plans

View the forensic science customized animation for an Introduction to Databases at the project Web site:
<http://databasesmanymajors.faculty.asu.edu/>

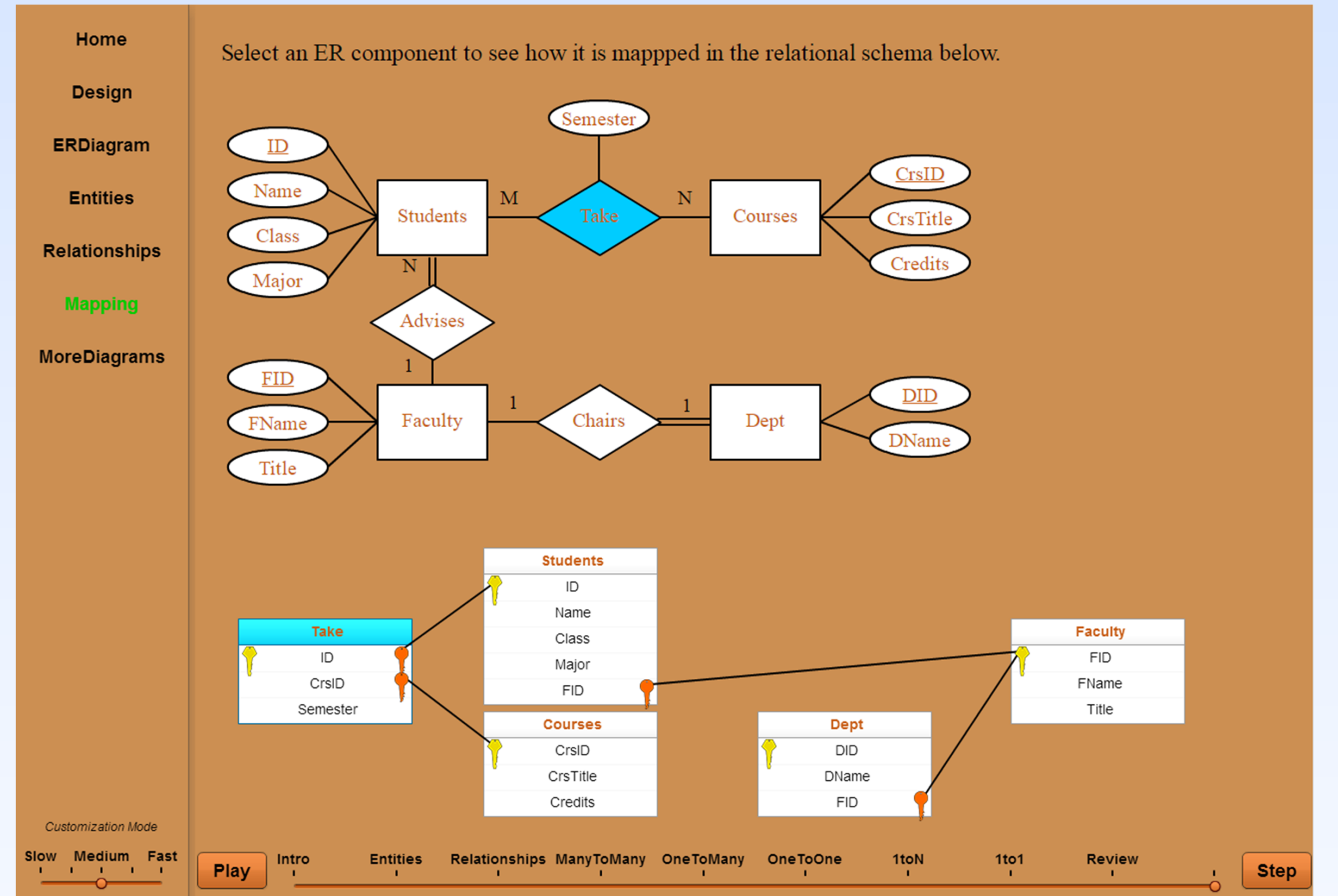
The customization of the Query DB animations for the forensic science discipline will begin in mid-February, 2017. The customization of Query DB will include animations which show the query graphically, as well as the SQL Standard as shown below.

select T.Semester
from Students S, Take T
where S.ID = T.ID and
S.Name = "Jeff Carter" and
T.CrsID = "CSE 303"

Last, list the attributes wanted in the query result in the select clause.
Note that there is a shortcut for selecting all attributes of a table:
select * from table

S: Students (ID, Name, Class, Major) = "Jeff Carter" = T: Take (ID, CrsID, Semester) = "CSE 303"

A customizable animation that students can use to understand the design of a database, Design DB, is also underway. The image below depicts an Entity-Relationship (ER) diagram which assists the database designer in asking and answering questions about the concepts and associations represented on the ER diagram.



Acknowledgements

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References

- Dietrich, S. and Goelman, D. Project Summary: NSF DUE-1431848/DUE-1431661, September 2014 - August 2017. Databases for Many Majors: Customizable Visualizations to Improve STEM Learning
- <http://databasesmanymajors.faculty.asu.edu/>