CS346 - Transaction Processing

Markus Breunig

Textbook:

Jim Gray, Andreas Reuter
Transaction Processing - Concepts and Techniques
Morgan Kaufmann, 1992

These lecture notes closely follow the notes used by Prof. Garcia-Molina in the previous years.

Introduction

TRANSACTION

Definition 1

- Operation consisting of multiple actions
- Actions access shared, persistent state
- Typically: relatively simple, pre-defined, few types
- Examples: banking, inventorycontroll, airlines

Definition 2

- Collection of actions requiring the ACID properties
  T_1: a_1 a_2 a_3 ... a_n

A Atomicity
C Consistency
I Isolation
D Durability

Note: A, I, D properties guaranteed by the system
C property of system AND transaction itself

Announcing the new MEGATRON 5000 TP SYSTEM

```
while TRUE do
   begin
      accept  NewTransaction
      print "ABORTED ***"
   end;
```

Other possibility: MEGATRON 5000/32

```
while TRUE do
   begin
      accept  NewTransaction
      print "System unavailable - try again later"
   end;
```

$\Rightarrow$ Need additional property:

A Availability:
At a given time there is a good chance that the transaction will complete successfully.

MEGATRON 6000 Series "All Natural"

Features:

- Your transaction handled by experienced craftsmen
- We only do one transaction at a time
- Your output hand chiseled on stone tablets

⇒ Need another additional property:

F Fast

Homework assignment: Need new acronym

A C I D A F

D: Persistent, ...
F: Performance, Rapid, High performance, ...

Other desired features?

S secure
E easy to use, program

Focus of course: How to achieve ACID-AF system

Examples:

Chapter 3	Fault tolerance	(CD-A)
Chapters 7, 8	Locking	(I)
Chapters 9, 10	Logging	(A)
All chapters		(F)
No chapter		(Easy)

Theme: Coping with

- Failures
- Concurrency
- Complexity

Transaction Processing System

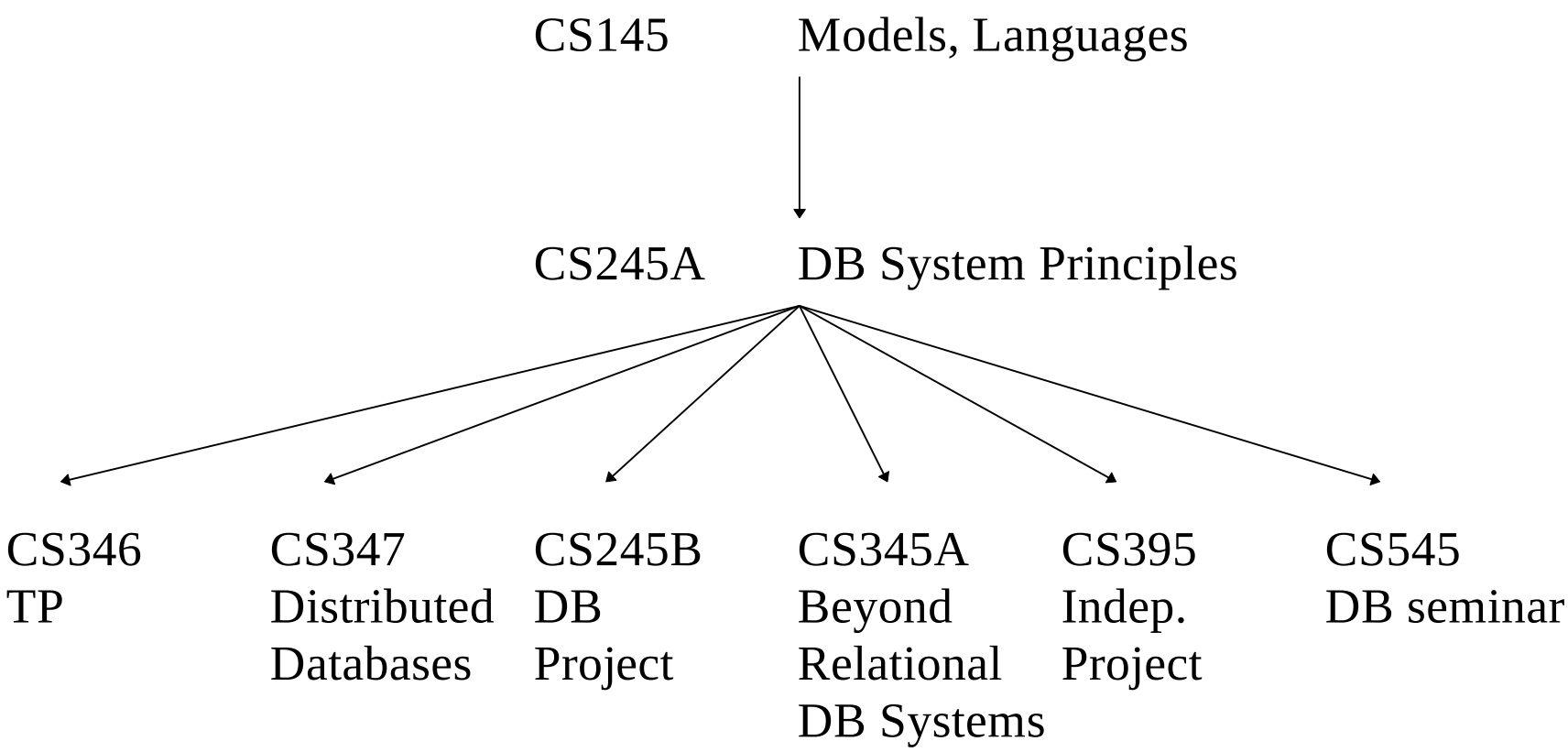
Definition

- System that performs transactions.

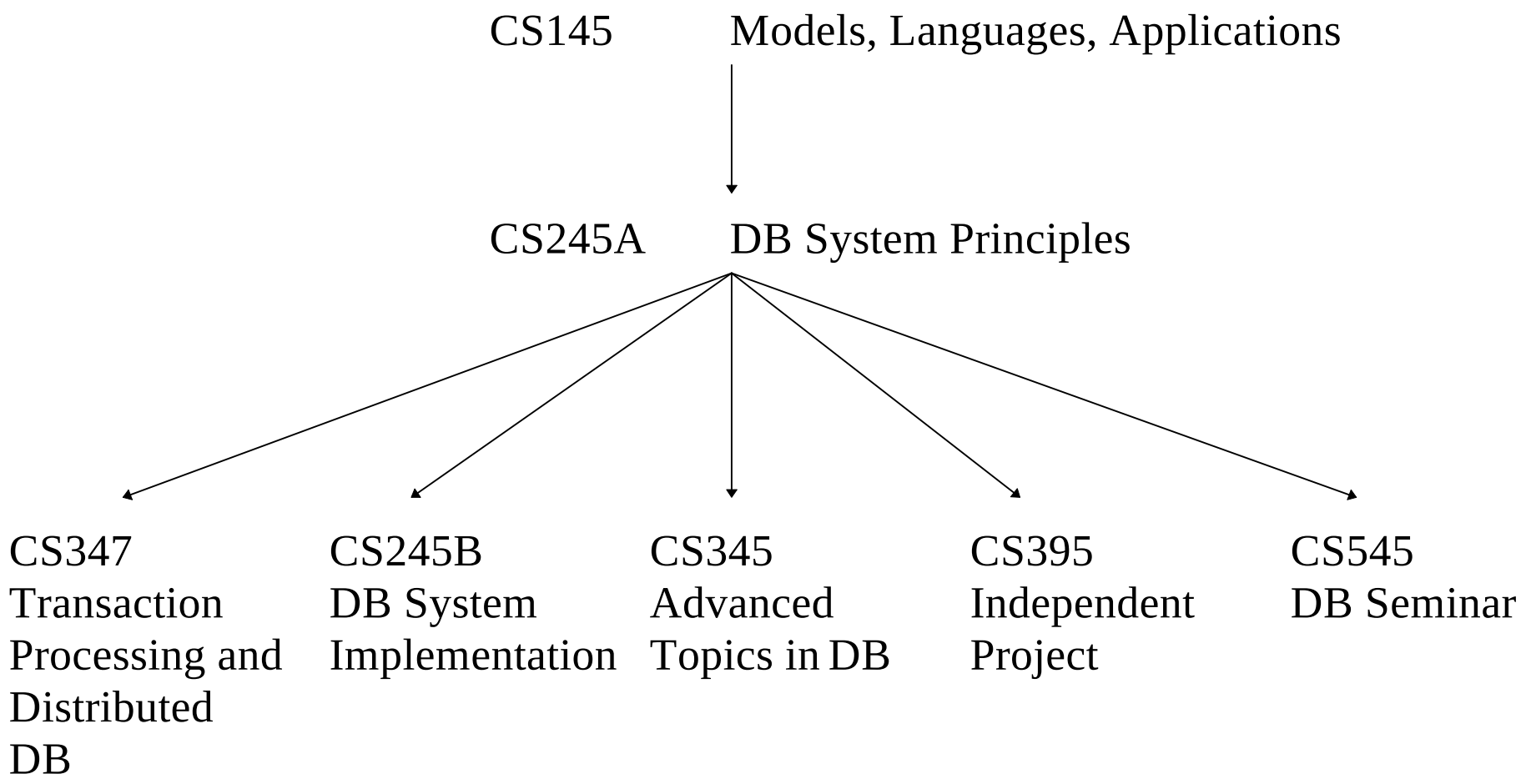
Examples:
- traditional: banking, airlines, ...
- now: any DBMS
- trend: wider use, e.g. transactional RPC

other examples:
- UPS - tracing packages
- Walmart - data mining
- Office applications

Where does CS346 fit in? (old organization)

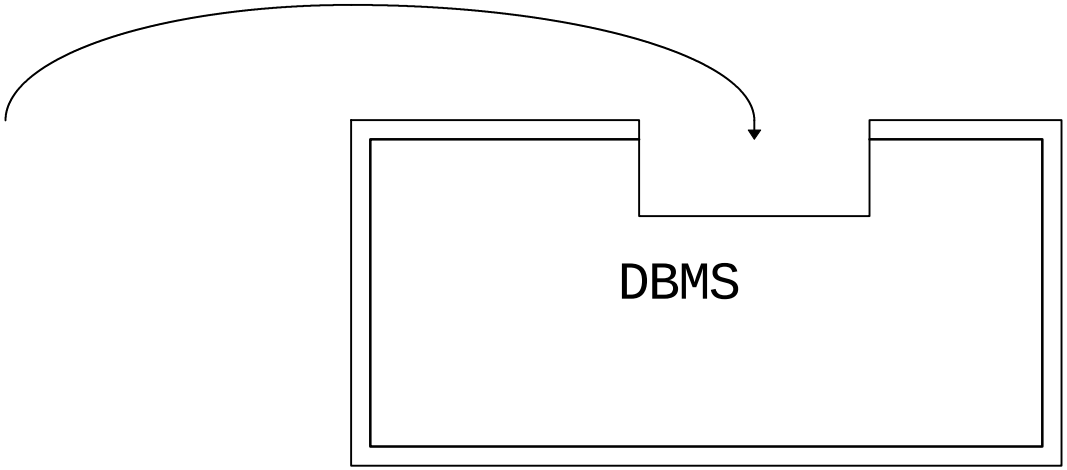


Where does CS346 fit in? (new organization)



The CS245 view of TP:

```
BEGIN TRANS;
READ(X);
WRITE(Y);
...
END TRANS;
```



DBMS: does locking, logging, ...
guarantees **serializable** schedules

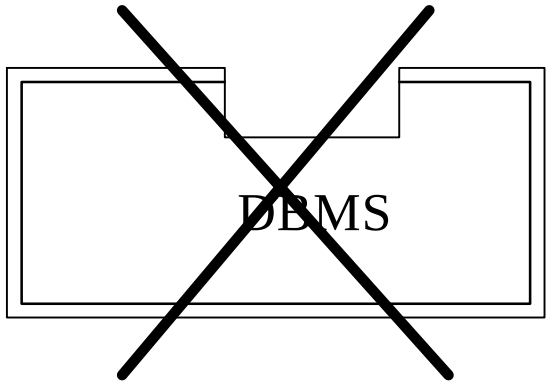
Questions:

1) user request ⇒ running program?
   (at ATM you do not say '`BT; READ(X); ...` ")

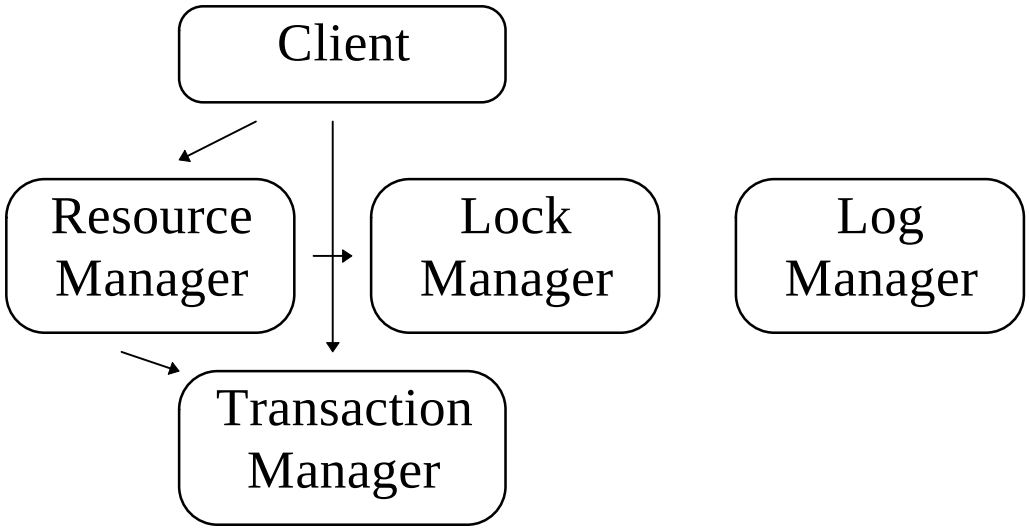
2) what is transaction code?
   SQL calls? C program? Menu choice?

3) what runs code?
   Process? Thread? System?

4) what are components? Interfaces?
   lock manager? log manager?
   ⇒ trend to **open** systems:



⇒



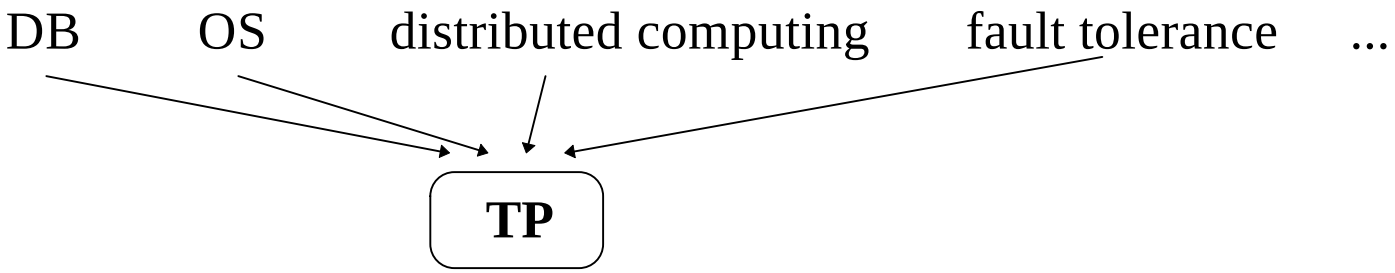
More Questions:

5) how are transactions used in non-DB applications?
   eg. transactional RPC

6) how to achieve **F** (fast) ?
   "tricks of the trade"

7) other parts of the picture:
   - communications
   - application writing
   - system administration
   - ...

** this is not just a DB course!!



Claim:

30%-50% of all computing $ go to TP applications.

Plus:

TP technology $\Rightarrow$ new applications

$\Rightarrow$ **TP important**

but:

usually not covered in classes, textbooks

Gray & Reuter Book:

NOT a great textbook, BUT the only one!

- too many details sometimes
- not very precise sometimes
- "here is how things work in practice - don't ask why"
- organization could be better ($\Leftrightarrow$ use glossary)
- use bug report
- good glossary

Outline of the book:

1) Introduction
2) Base Terms
3) Fault Tolerance
4) Transaction Models
5) TP Monitors
6) "
7) Isolation
8) "
9) Logging & Recovery
10) "
11) "
12) Advanced TP Topics
13) Sample RM
14) "
15) "
16) System Surveys

Reading Assignments

Ch. 1:	all except 1.3 (skim)	try problems 1, 3, 6
Ch. 2:	skim all, except skip 2.7	try problems 1, 10, 14
Ch. 3:	all except skip 3.7.4	try problems 1, 5, 12, 22
Ch. 4:	skip all (for now)	
Ch. 5:	all except skip 5.5.4	
Ch. 6:	all except skim 6.5.1, skip code in 6.4	
Ch. 7:	should already know 7.1 - 7.5	
	read 7.6, 7.7	
	should already know 7.8.1-7.8.3	
	read 7.8.4, 7.8.5	
	skip 7.8.6 - 7.8.8	
	read 7.9, 7.11	
	skip 7.10, skim 7.12	
Ch. 8:	all except skim 8.5, 8.6	
Ch. 9:	all	
Ch. 10:	all except skim 10.3.7.2	
Ch. 11:	all, skip 1-bit RM	