

CMSC 191

Temporal Databases

Reginald Neil C. Recario

Institute of Computer Science

University of the Philippines Los Baños



Overview



- Temporal Database Definition
- Applications
- Data Types

Temporal Database

- Database system can store and query data involving time

Temporal Database Definition

- A **temporal database** is a database with built-in support for handling data involving time, for example a temporal data model and a temporal version of Structured Query Language (SQL).
(Wikipedia, 2014)

Temporal Database Definition

- A **temporal database** encompass all database applications that require some aspect of time when organizing their information (Elmasri and Navathe, 2007).

Temporal Database Uses

- ***financial applications*** such as portfolio management, accounting, and banking
- ***record-keeping applications*** such as personnel, medical-record, and inventory management

Temporal Database Uses

- ***scheduling applications*** such as airline, train, and hotel reservations
- ***project management***
- ***scientific applications*** such as weather monitoring.

Two Kinds of Time

- Kinds of time:

- ▣ Valid-time

- ▣ Transaction time

- Three temporal facts:

- ▣ Valid-time

- ▣ Transaction-time

- ▣ Bitemporal

Valid-time Facts

- They constitute any fact from the past, present or future.
- Represented by timestamp with valid-times in reality.
- Defined using a given calendar (e.g. Julian) and given granularity (e.g., hour level)

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Valid-time Facts

- Ups: update in real time with retroactive or postactive effect
- Downs: cannot keep track of updates (deletions) and correction of errors

Transaction-time Facts

- Keep track of the manipulation of facts by the DBMS
- Keeps the execution time of transaction manipulating the fact
- Adopts the schedule operated by the system

Transaction-time Facts

- Ups: Can maintain history of all facts regardless of being valid or erroneous, past or current.
- Downs: Cannot keep a history of future facts and only current facts can be updated. Also updates can not be made by retroactive or postactive effect.

Temporal Data Types (MySQL)

- Data types in MYSQL:
 - ▣ DATE (e.g. 2014-12-25)
 - ▣ TIME (e.g. 10:00)
 - ▣ YEAR (e.g. 2014)
 - ▣ DATETIME (2014-12-04 06:00:45)
 - ▣ TIMESTAMP (2014-12-04 06:00:45)

Temporal Data Types (MySQL)

- When to use DATETIME and
TIMESTAMP?

Temporal Fact – Valid-time

- The **valid time** denotes when facts are true with respect to the real world.
- Example:

citizen	birthday
Juan Dela Cruz	1990-12-12
Antonio Luna	1990-08-17
Deo Gracias Pua	1997-01-22

Temporal Fact – Transaction-time

□ The ***transaction time*** of a database fact is the time when the fact is current in the database.

□ Example:

account no	amt withdrew	Transaction date
11745710	34500.00	2014-02-14 19:00:00
18845623	800.00	2014-10-22 08:15:45

Temporal Fact – Bitemporal

- The ***bitemporal database*** represents both the valid time and transaction time.
- Example:

item	qty	validfrom	validto	received
Tide Bar	55	2014-11-12	2015-11-12	2014-12-05
Mongol	90	2014-11-12	9999-12-12	NULL

Temporal Data

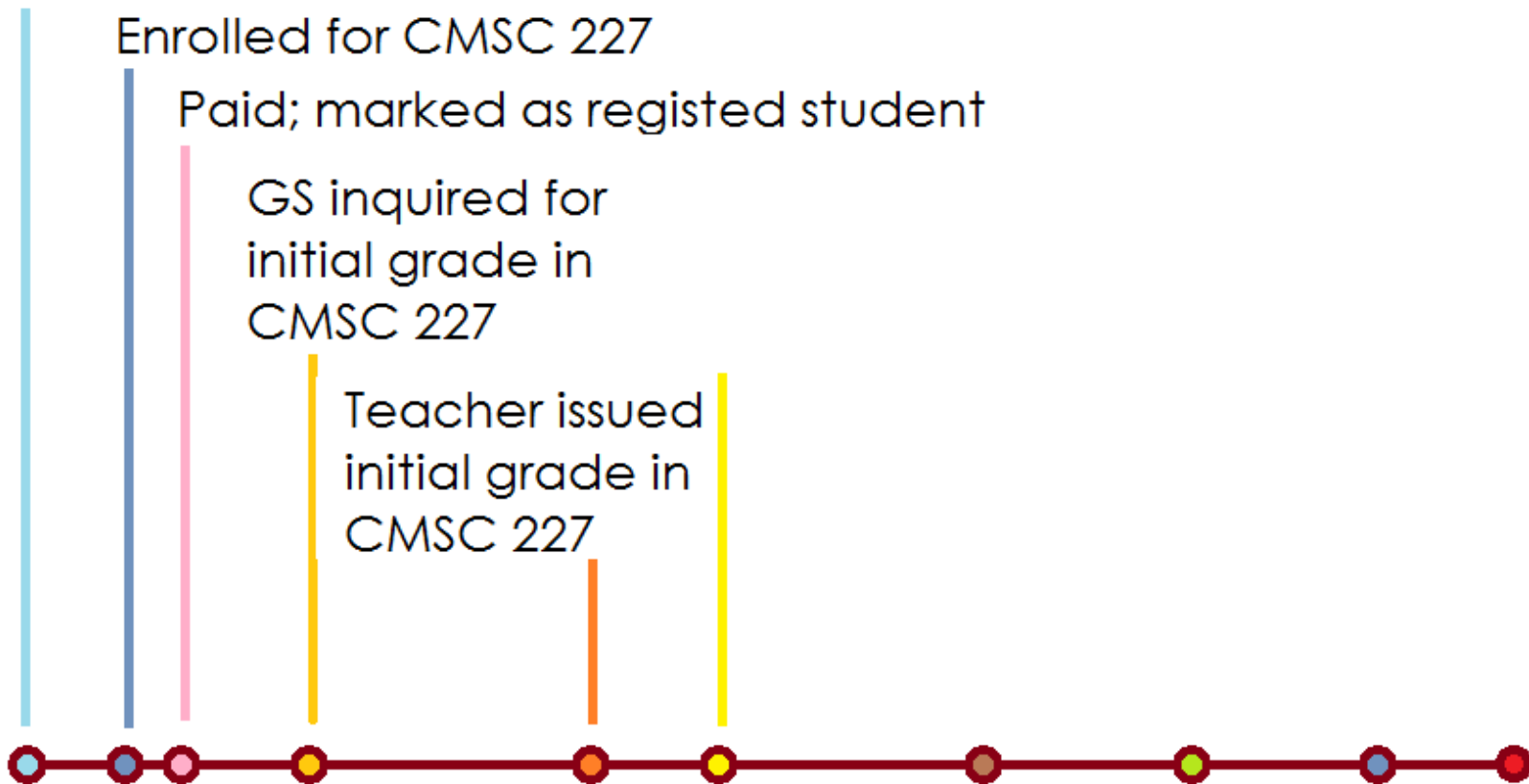
Enrolled in the MIT UPLB Program

Enrolled for CMSC 227

Paid; marked as registered student

GS inquired for
initial grade in
CMSC 227

Teacher issued
initial grade in
CMSC 227



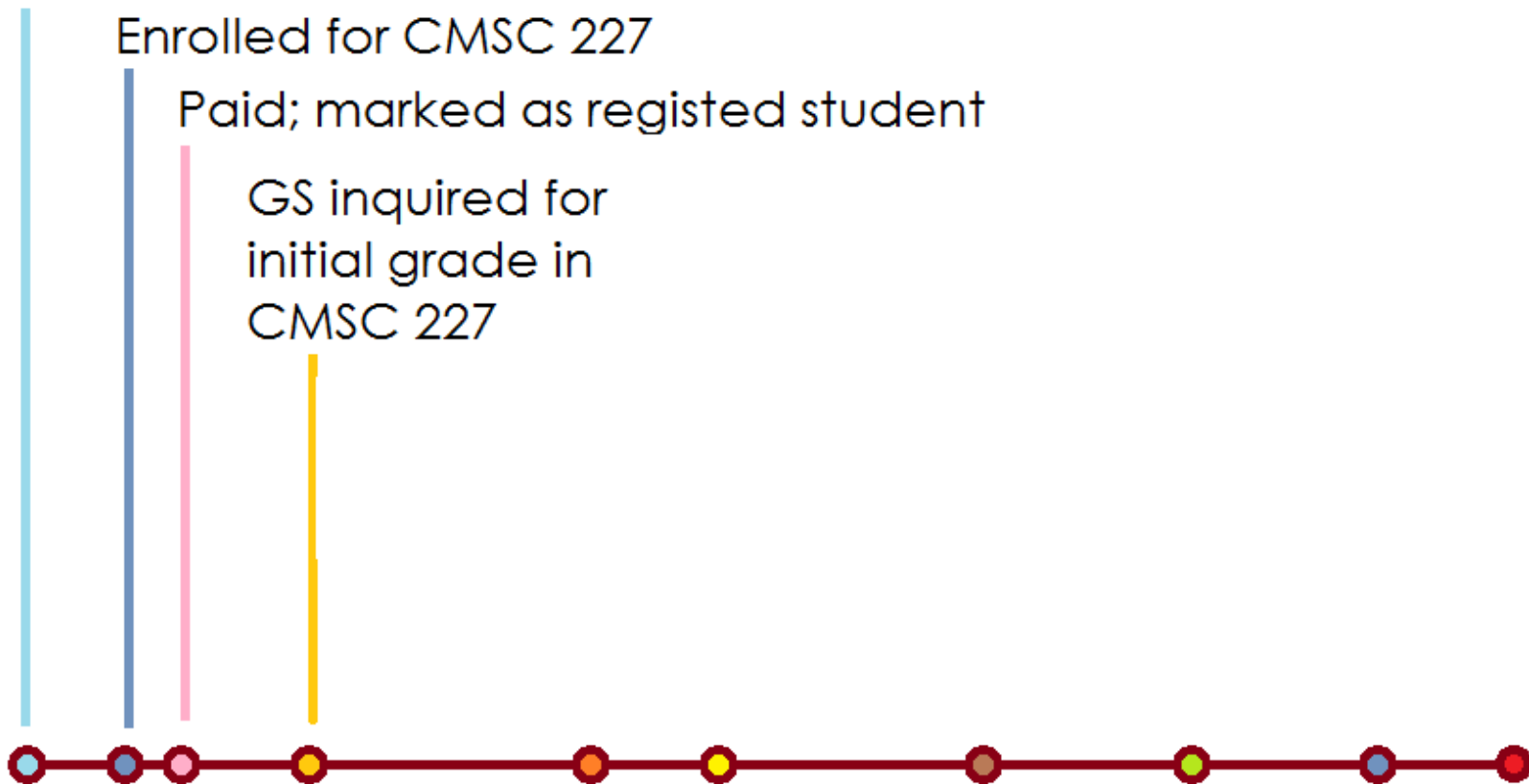
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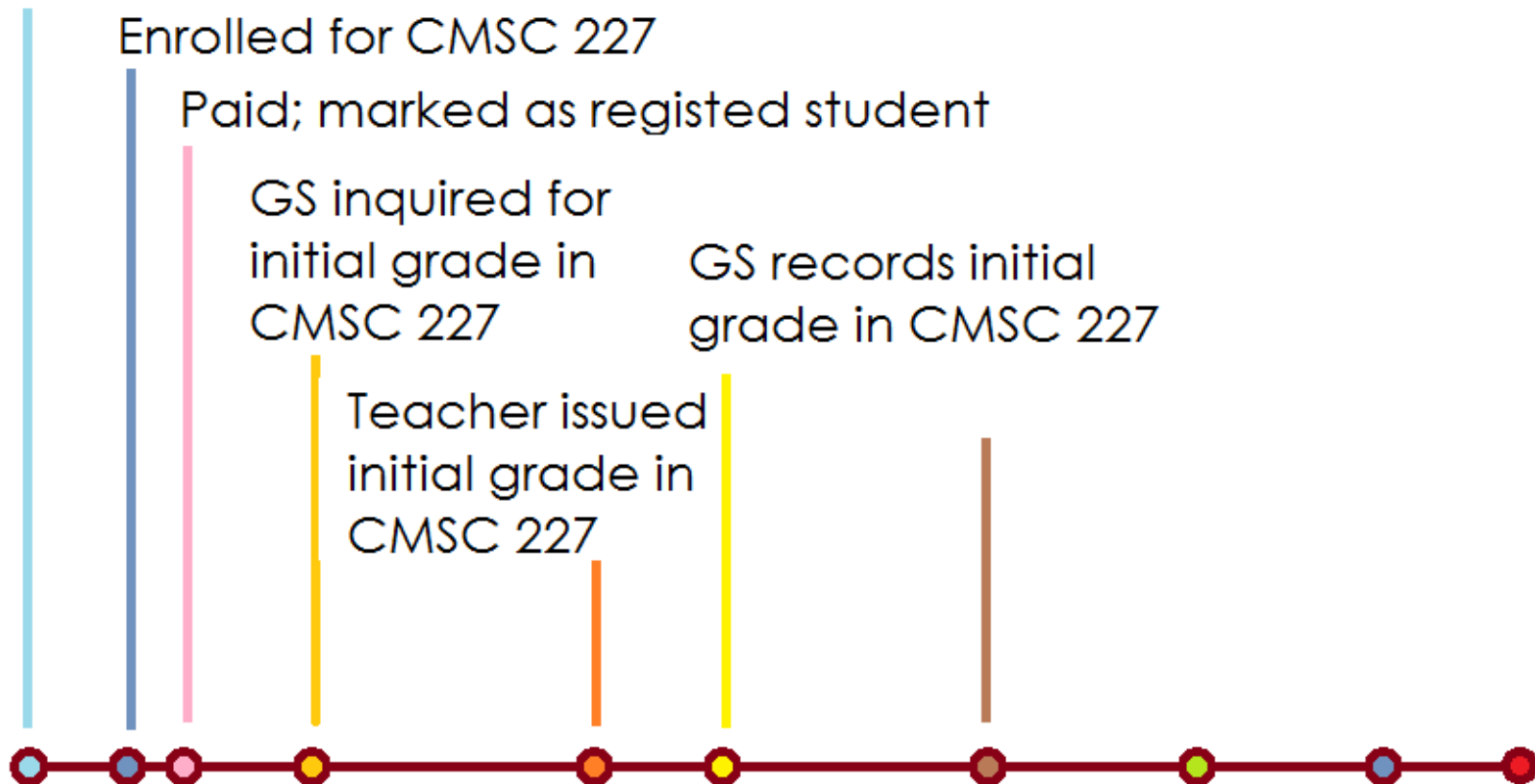
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Student takes
Compre Exam

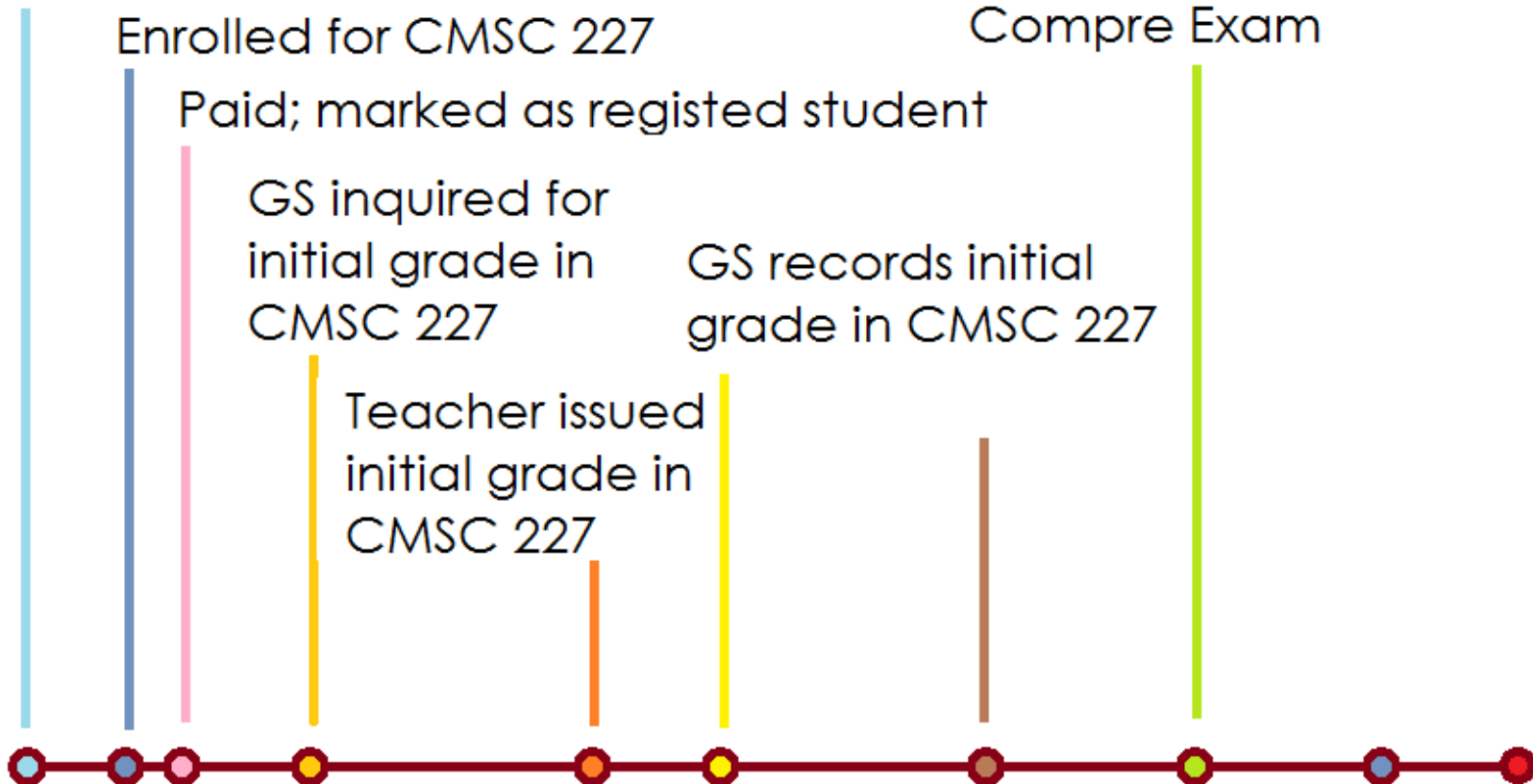
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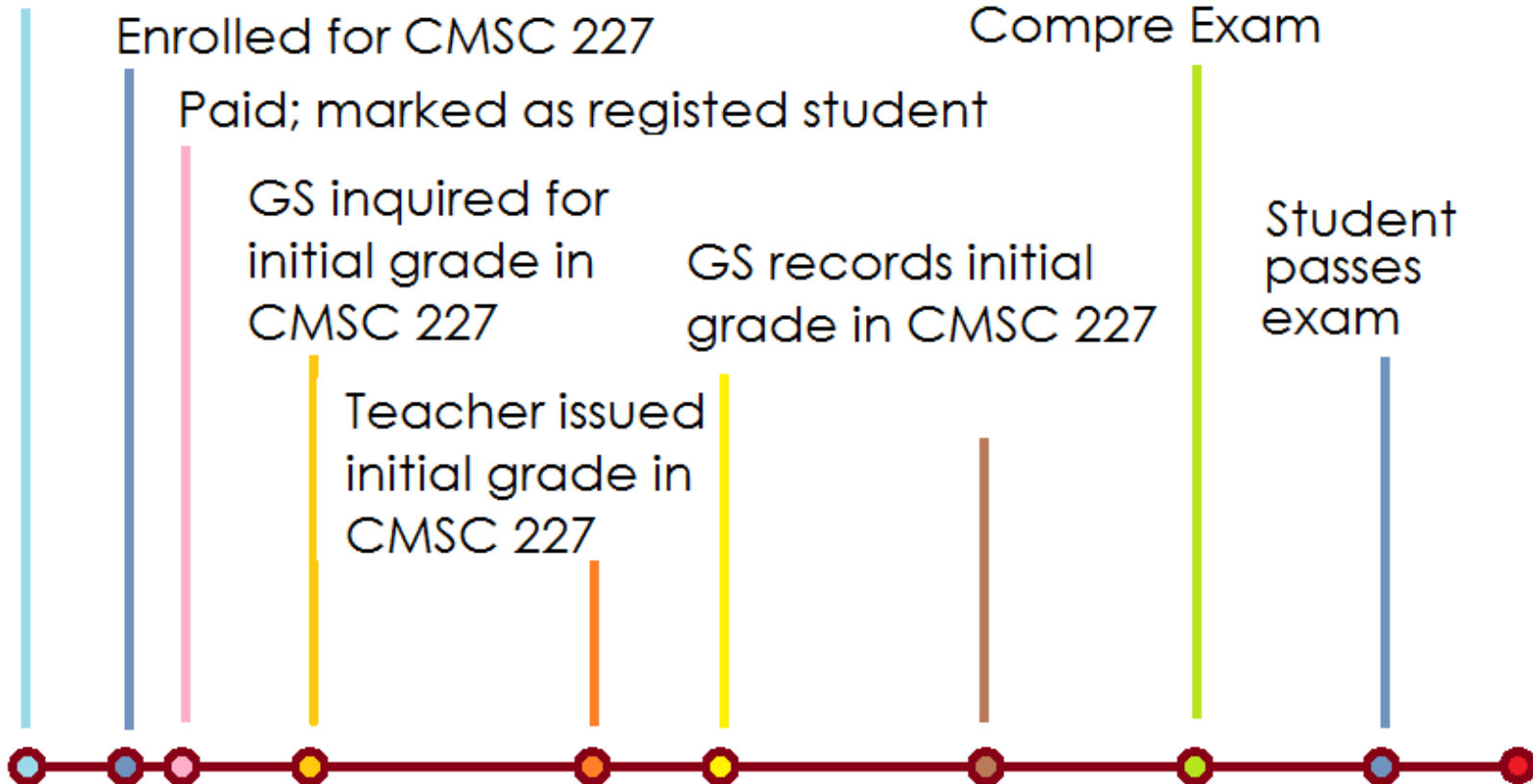
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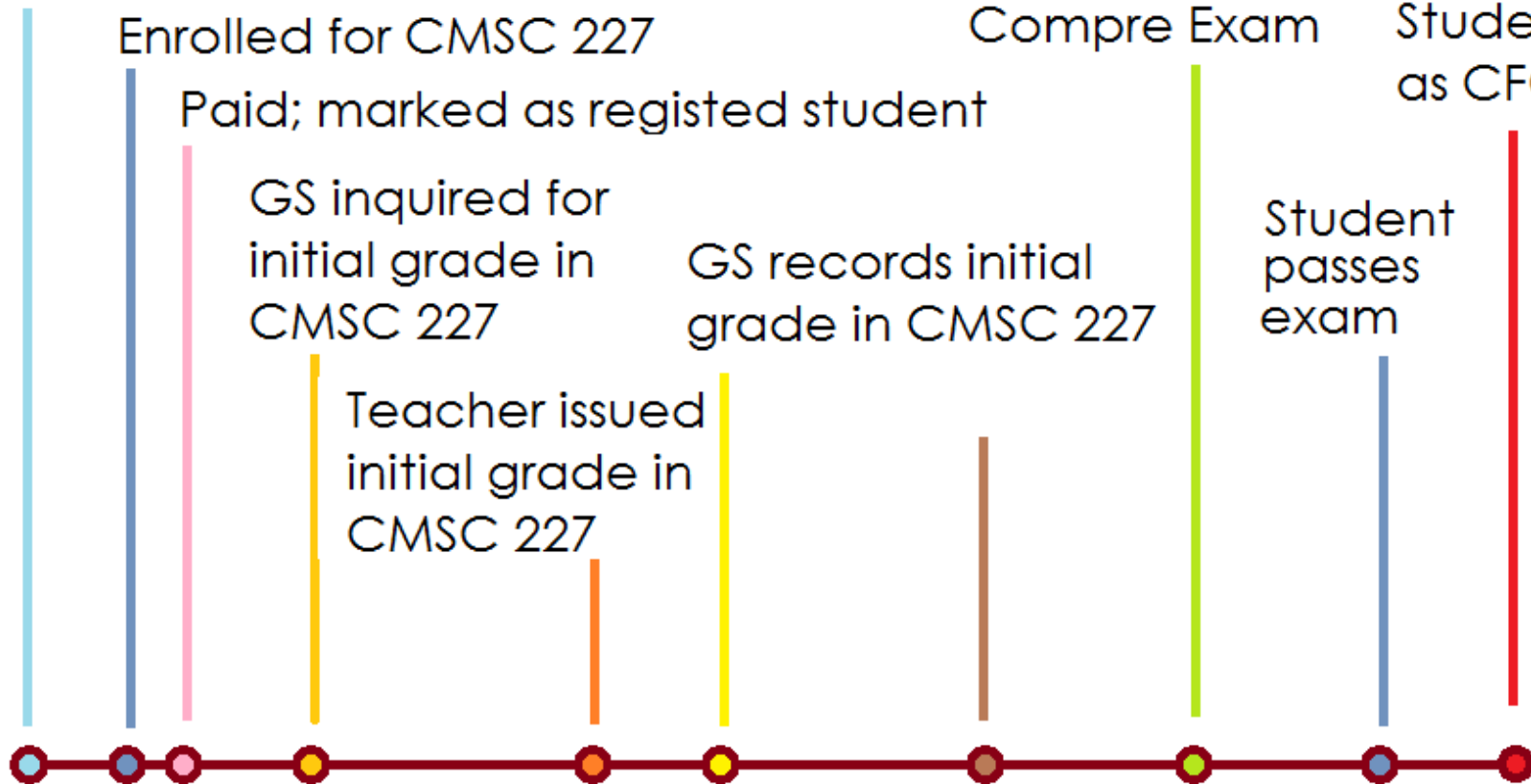
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Temporal Tables

- Classified into two namely as:
 - ▣ ***Event tables*** – stores timestamps
 - ▣ ***State tables*** – stores interval timestamps

Temporal Tables Example

□ Event table:

student	date passed assignment
Juan Dela Cruz	2014-10-11 23:59:99
Juana Change	2014-10-12 00:00:10

Temporal Tables Example

□ State table:

student	consult start	consult end
Juan Dela Cruz	2014-10-11	2014-10-18
Juana Change	2014-10-12	2014-10-18

Interval operations

- Since intervals are represented as pairs of timepoints, comparisons between intervals are based on timepoint comparisons of the upper and lower bounds.

Interval operations

- The interval comparison operators are BEFORE, AFTER, DURING, CONTAINS, OVERLAPS, MEETS, STARTS, FINISHES, and EQUAL.

Interval operations

- Let I_1, I_2 be two intervals, and $\text{begin}(I)$, $\text{end}(I)$ be respectively the lower bound and upper bound of the interval I .

Interval operations

	Comparison operator	Meaning
1	I1 before I2	$I1_E < I2_S$
2	I1 after I2	$I2_E < I1_S$
3	I1 during I2	$(I1_S > I2_S \wedge I1_E \leq I2_E) \vee$ $(I1_S \geq I2_S \wedge I1_E < I2_E)$
4	I1 contains I2	$(I2_S > I1_S \wedge I2_E \leq I1_E) \vee$ $(I2_S \geq I1_S \wedge I2_E < I1_E)$
5	I1 overlaps I2	$I1_S < I2_S \wedge I1_E > I2_S \wedge$ $I1_E < I2_E$
6	I1 overlapped_by I2	$I2_S < I1_S \wedge I2_E > I1_S \wedge$ $I2_E < I1_E$

Interval operations

	Comparison Operator	Meaning
7	I1 meets I2	$I1_E = I2_S$
8	I1 met_by I2	$I2_E = I1_S$
9	I1 starts I2	$I1_S = I2_S \wedge I1_E < I2_E$
10	I1 started_by I2	$I1_S = I2_S \wedge I2_E < I1_E$
11	I1 finishes I2	$I1_S > I2_S \wedge I1_E = I2_E$
12	I1 finished_by I2	$I2_S > I1_S \wedge I1_E = I2_E$
13	I1 equivalent I2	$I1_S = I2_S \wedge I1_E = I2_E$

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