Faculty of Arts and Science
University of Toronto

Midterm Test

Department: Computer Science
Instructor: Steve Easterbrook
Date and Time: 9:10am, Friday November 1, 2002

Conditions: Closed Book
Duration: 50 minutes

This test counts for 20% of your final grade

Name: _____
(Please underline last name)

Student Number: _____

Question Marks

1 _____/20

2 _____/20

3 _____/30

4 _____/30

Total_____/100

1. [Short Questions; 20 marks total]

(a) [Systems Theory – 5 marks] Give one example of each of (1) a natural system, (2) a designed system and (3) a human activity system. For each example, list some of the inputs and outputs it has with its environment, and identify at least one control mechanism that keeps the system working.

A natural system: **A river**. Inputs: Water, plants and debris that fall in, etc. Outputs: Water (into the sea); water vapour (by evaporation), fish (extracted by fishers!), etc. Control: the flow of water keeps the river's path clear, which means the river keeps flowing that way.
[Many other possible examples, eg: the weather, an ecosystem, a rock, a plant, the human body, an organ of the human body, etc...]

A designed system: **A car**. Inputs: Fuel, passengers, oil, spare parts, etc. Outputs: exhaust, passengers (at their destination), oil dripping from a leak, etc. Control: the driver controls the car to prevent it crashing, the engine keeps it moving towards a destination.
[Many other possible examples, eg: a computer, a building, a coffee machine, the filing system in my office, etc.]

A human activity system: **A football team**. Inputs: new players, food, training, advice from the coach, sponsorship money. Outputs: scores, damage to football fields, happy spectators, players (when they leave or retire). Control: The coach keeps the team working together.
[Many other possible examples, eg: will do: e.g. a business, a market, parliament, a club, , the entire NFL, a meeting, a lecture, a course, etc…

(b) [Feasibility Analysis – 5 marks] What is the difference between technical feasibility and operational feasibility? Give an example of a question you might ask (of a stakeholder) when assessing each of these two types of feasibility.

Technical feasibility refers to what is technologically possible, and whether the necessary technology can reasonably be obtained for the project, within the project's constraints. Operational feasibility concentrates on whether it will be possible to use and maintain the proposed system, and whether its users will accept it. A key difference is focus: technical feasibility focuses on the building of the system, while operational feasibility focuses on what happens after delivery.

Example questions for technical feasibility: "what performance/information throughput/data size/ do the users expect?"; "What technology is available in house?"

Example questions for operational feasibility: "what experience do the users have of similar systems?"; "are there any legal or social issues?"; "how important/urgent is this problem to the end users?"

(c) [Information Acquisition – 5 marks] Name two different techniques for gathering information when doing a requirements analysis, and state the advantages of each.

Interviews: advantages: rich collection of information, can probe in depth and ask followup questions; can assess opinions, feelings, goals, etc.

Questionnaires: can quickly collect data from a large number of people, can be administered remotely, can ask about attitudes, beliefs, etc.

[Many other possible techniques: Introspection, background reading, Hard Data analysis, meetings, focus groups, JAD/RAD sessions, ethnography, etc…]

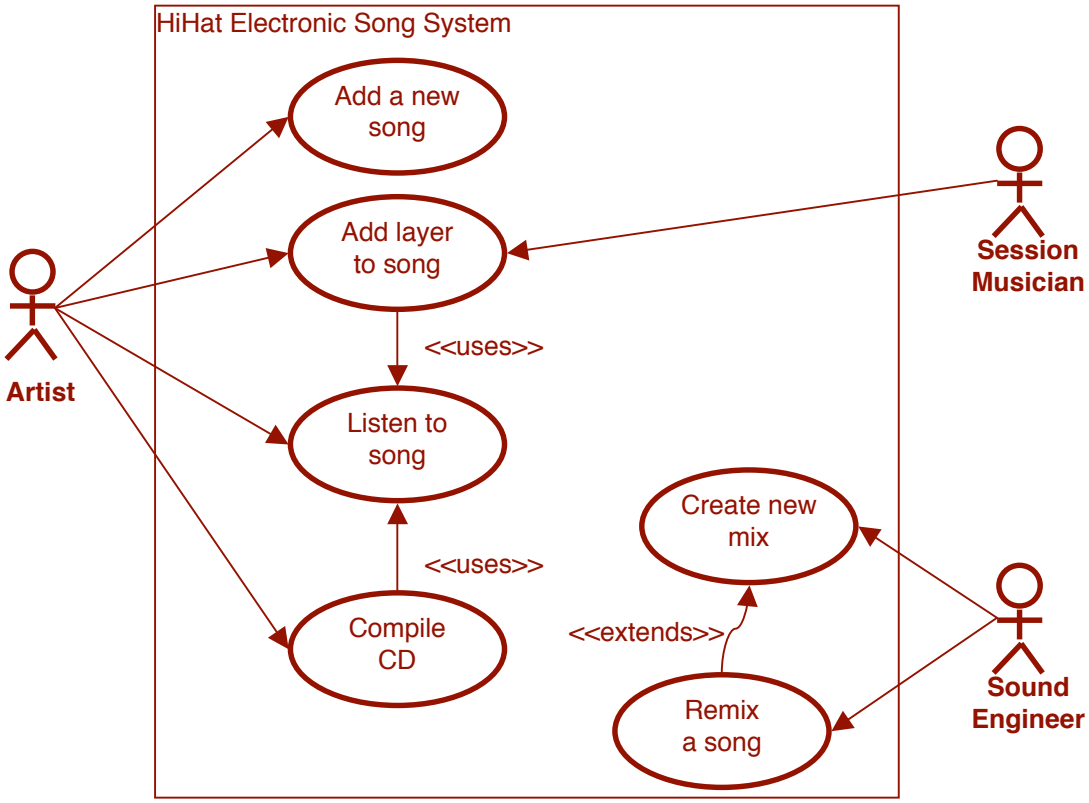
(d) [Business Rules – 5 marks] When a band releases a new CD, the record company presses a certain number to send to the stores. When this first pressing starts to run out, they use the following rule to decide whether to press more copies of a CD, and whether to run more adverts: "If it's the band's first album and it either had good reviews or sold more than half the original pressing in the first month of release then readvertise and press more copies. If it's not the band's first album, we don't bother readvertising, and we only press more copies if more than half the original pressing was sold in the first month." Draw a decision table to represent this business rule.

First album?	Y	Y	Y	Y	N	N	N	N
Good reviews?	Y	Y	N	N	Y	Y	N	N
Sold >50% in 1st month?	Y	N	Y	N	Y	N	Y	N
Press more?	X	X	X		X		X	
Re-advertise?	X	X	X					

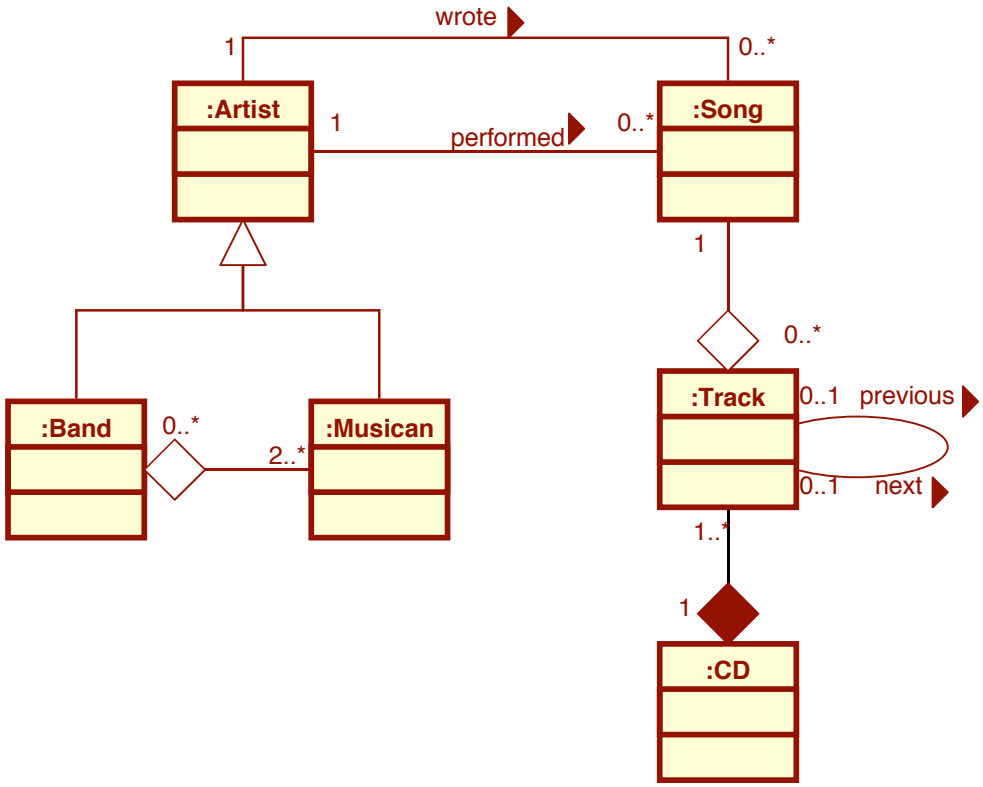
(Or one of several possible reduced versions – reduced version is not necessary to get full marks):

First album?	Y	Y	Y	N	N
Good reviews?	Y	N	N	*	*
Sold >50% in 1st month?	*	Y	N	Y	N
Press more?	X	X		X	
Re-advertise?	X	X			

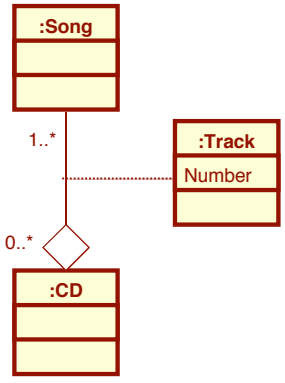
2. **[Use Cases – 20 marks]** The HiHat Recording Studio is used by artists to record songs for release on CD. The studio is planning a new system to store all recorded songs electronically. Artists can add new songs and listen to songs. The can also add layers (of sound) to an existing song, and compile a CD out of previously recorded songs, both of which will involve listening to the songs. Sometimes artists hire session musicians to add layers to their songs, but session musicians cannot create new songs or compile CDs. A sound engineer can create a new mix for a song (by adjusting the various layers of sound). If a musician is unhappy with a mix, the sound engineer can remix it – which really just means creating a new mix to replace the old one. Draw a use case diagram for the proposed system.



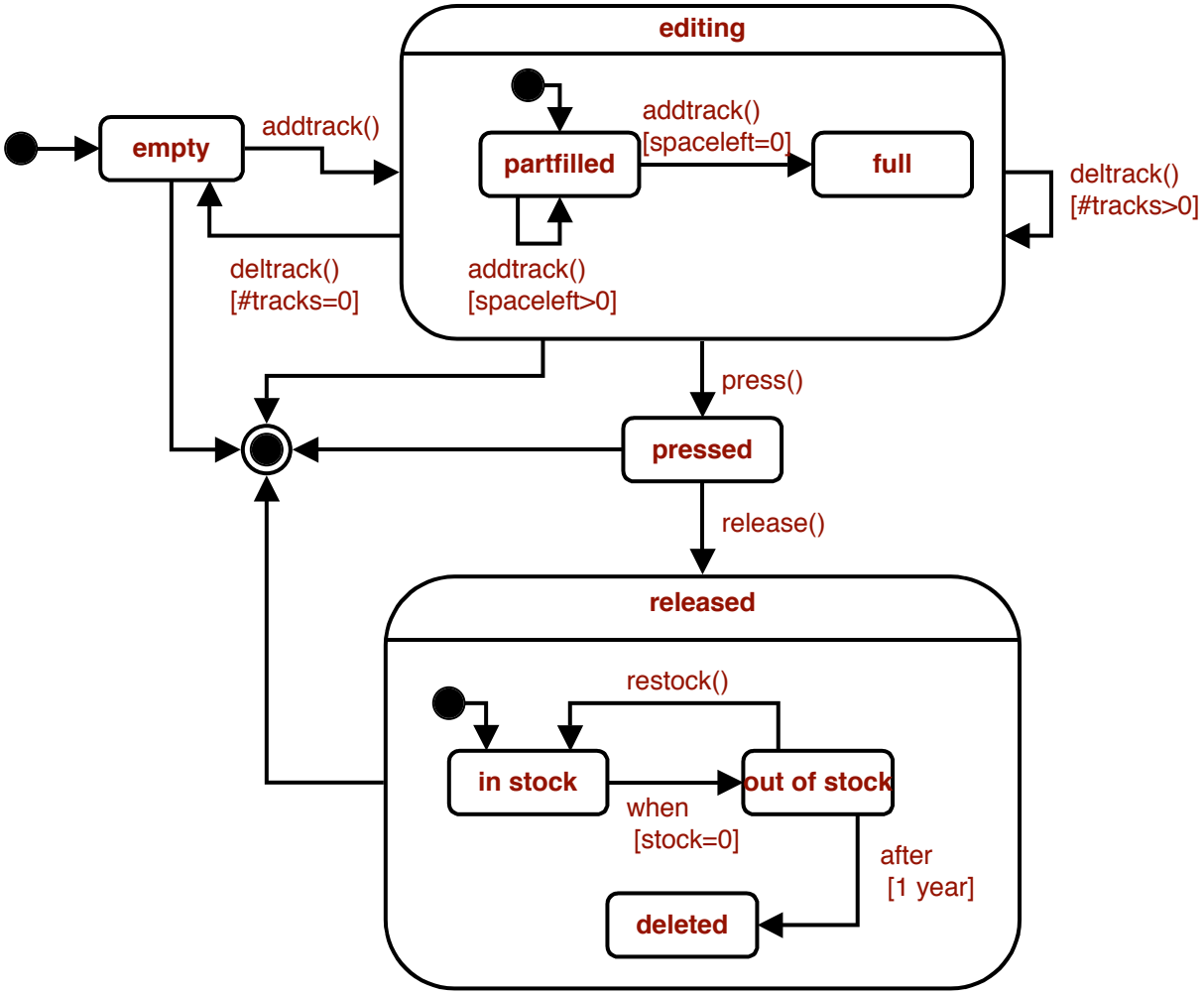
3. **[Class Diagrams – 30 marks]** An artist is either a band or a musician, where a band consists of two or more musicians. Each song has an artist who wrote it, and an artist who performed it. [Note: for this system, "song" means a *recording* of a piece of music, so that if a piece of music is recorded more than once (say, by different artists), we treat them as different songs]. Therefore, each song is performed by exactly one artist, and written by exactly one artist. A CD is composed of a number of tracks, each of which contains exactly one song. However, a song can be used in any number of tracks, because it could appear on more than one CD (or even more than once on the same CD!). Because the order of the tracks on a CD is important, the system will need to know for any given track what the next track is, and what the previous track is (if there is one). Draw a class diagram for this information, and be sure to label all the associations with appropriate multiplicities.



Notes: UML provides notation for ordered compositions, but we haven't met it yet, so the previous/next association is the obvious solution. Track could also be modeled as an association object:



4. **[Statechart Diagrams – 30 marks]** Draw a statechart diagram for the CD object that will be stored by HiHat's new system. When a CD object is first created, it is empty. The artist can then add tracks to it, if it is not full. The artist can also delete a track if the CD is not empty. When they have finished adding tracks, the artist will request that the CD be pressed, ready for release, even if it is not full (although requests to press empty CDs should be ignored!). The CD stays in this state until the record company releases it. Once the CD is released, it stays released for the rest of its life. However, during this state, the CD can either be in stock (i.e. copies are available for sale), out of stock (i.e. no copies are available, but the record company may create another pressing soon, to put it back in stock), or deleted. Deletion occurs automatically if and only if the CD has been out of stock for more than a year, after which no further pressings can be made. Note: a deleted CD is still considered to be 'released'.



Notes: The "editing" superstate isn't really necessary, but it simplifies drawing the deltrack and press transitions. It's not clear from the question what "full" means – in reality tracks are different sizes so that one track might fit in the space left but another may not. Also, it's possible that adding one track to an empty CD could make it full. The above answer ignores both these issues.

[scratch paper]

[scratch paper]