These suggestions were written for use in training new instructors for computer science recitations sections, yet they should have some use for any course in which the instructor wishes to increase the amount of interaction and discussion that occurs within a classroom. The distinguishing feature is that the classroom is viewed as an occasion not only for learning, but for communicating. Further, learning is seen as something that can occur through interaction with others. If one assumes this, then the instructor takes on the particular role of group facilitator.

Generally, a facilitator is responsible for the managing the processes a group uses, typically during a meeting. A facilitator is often a professional, someone who has received special training in structuring and directing group dynamics. (An accessible treatment of facilitation is given by R.M. Schwarz in The Skilled Facilitator, 1994).

Being more of a consultant to a group, the facilitator is usually not the group leader (although a group's leader may display strong facilitation skills). And most discussions of group facilitation do not consider facilitation in an educational context. Certainly, there are theories of teaching that discuss the instructor as a facilitator for student learning, but these use 'facilitation' in a different sense, one that emphasizes the student--knowledge relationship and the role of the instructor to help develop and nurture that relationship. Yet instructors cannot simply act as a facilitator in the sense we mean it here--a manager of a group's communication and interaction. They must facilitate learning as well.

This document begins by setting out a starting point in terms of assumptions, learning outcomes, and general characteristics of an approach. It is here that I unpack possible links between observed behaviors in the classroom and learning objectives. Next are several strategies for creating an interactive classroom climate. The final section provides specific strategies for an instructor acting as facilitator of group interaction and processes.
Some Starting Assumptions:

1. 'Collaboration' in its strict sense is not the issue. The use of the term 'collaboration' represents a desire on the part of the instructor for students to be able to engage with each other in various aspects of a task to improve their performance and the quality of their work. As such, it is less appropriate to concentrate on the specific skill of 'collaboration' as recognized in the literature on interaction and more appropriate to develop the suite of skills that are important generally to working effectively with others in any number of specific situations. These include skills in the general areas of discussion, planning, communicating with others in one-on-one and small group meetings, problem-solving and decision-making procedures. Keep in mind that each of these areas can also be broken down into sets of specific skills, such as asking questions, body posture, tone of voice, and so forth.

2. While effective discussion and collaboration is important in itself, sometimes they are used as means to other ends. These include the ability to reflect, to handle ambiguity, to create or perceive alternatives, or to promote a supportive working culture. It may be better to address these ends directly, rather than trying to achieve them indirectly through the assigning of group work. One reason for this is that, based on our research, students actively seek to circumvent genuine group work, and therefore these other goals will not be achieved.

3. Activities that develop skills of interaction are possible at all levels of group size, from those involving the whole class down to those using dyads (pairs of students). Dyadic interaction is not necessarily more intense nor more effective than large group interaction in terms of student learning. The key element is whether the students are engaged in the situation. Placing students in smaller groups for discussion will not guarantee engagement, although properly facilitated they will.
4. Effective collaboration is not 'natural,' necessary, or even logical outcome of group assignments. Although students can cope with group work, even engaging in groups in a supportive manner, students in computer science and other engineering disciplines also often see collaboration as a burden, as a risky enterprise that is often better circumvented or hedged against by adopting strategies that turn group work into an aggregate of individual work. As with any discipline, students will be more effective collaborators with focused instruction.

**Some desired learning outcomes**

1. **Student performance:** Improvement of student ability in performing general intellectual tasks, in addition to those tasks relating to specific course content. These general tasks include the ability to be reflective, to be flexible and adaptable, to respond to ambiguity, to plan, and to interact with others.

2. **Classroom dynamics:** A supportive classroom environment that is marked by high levels of interaction and collaboration. The classroom thus provides, in effect, a laboratory for practicing desirable interaction activities. Another way to conceptualize it is as a community, where students are engaged with one another and with their common objectives. The question of whether such an environment is necessary for producing certain content-specific learning objectives is not considered here. This document assumes that creating these dynamics is desired.

**Elements of the Approach**

1. Bring interaction, discussion, and group work into the classroom, particularly in recitation. This is done explicitly and systematically.

2. Instructor's role changes to emphasize a) modelling desired behavior, and b) facilitation of desired interaction processes. Instruction utilizes a combination of instructor-led discussion and activities, structured small group activities, and unstructured small group activities.
3. 'Starting small' is acceptable. Benefits can be obtained even if not all of the programme is implemented.

**Strategies for Creating an Interactive Classroom Environment**

1. Incorporate questions into lectures. The use of questions should be planned. At first, questions may come from the lecture material but eventually the relationship could be reversed, with questions forming the backbone of the lecture. Include enough questions so that students will be speaking a minimum of 25% of the class time. Work up to students having students speak 75% of the time.

   General types of questions are:

   *Questions for reviewing.* 'What' questions. It should be reasonable to expect that the answer should be known by any of the students. There is usually a correct answer or a set of correct answers. Answering these questions should take very little effort on the part of the student. As such, they should be low risk. Incorrect answers should be treated as accidental misstatements. These are very useful for 'limbering up' students for interaction. They are also valuable for clueing students in to what the instructor sees as the concepts important for students to review for examinations. The instructor can then advise that if a student has difficulty answering these questions, the exam will be even more so. In this case, well chosen review questions offer the students a quick, interactive self-diagnostic.

   *Questions for reflection.* These are 'why' questions that ask for explanation. They are useful for having students make their reasoning explicit rather than assuming reasons are obvious or self-evident. These questions are particularly valuable for two types of students: those who are effective at 'intuiting' correct answers and those who cannot understand why the correct answer is correct. The first type will be challenged to become reflective about their own reasoning processes. The second will gain the benefit of seeing and hearing how one reasons from the problem to the solution. Because they deal with explicating processes, answers here are better or worse, rather than right or wrong.
Questions for reaching. These questions ask students to extend the material, perhaps by drawing connections or suggesting implications. For example, 'why is this important?', or 'what are the problems or criticisms of this?' Answers here are more or less interesting or insightful, but neither right or wrong, nor better or worse. It is important to allot sufficient time to the discussion of these questions, because the real value of these questions comes when students genuinely perceive they may pursue the answers in discussion with the instructor and with each other. Care should be taken to avoid posing the question as a 'fishing expedition,' where the students see the instructor looking for a specific, predetermined answer. To do so turns the discussion into a guessing game, rather than an opportunity for a shared exploration of ideas.

2. Develop informal relationships with and among students. The goal is to develop a climate of the easy flow of communication. A good sign is whether there is a 'buzz of conversation' before and after class.

One strategy for accomplishing this is to learn names as early as possible, and to say them in class regularly. One way to learn names is to take pictures, or other notes on individual students. Call on people by name. Or, if names are unknown, ask students first to give their names before giving their answer. When referring to an earlier comment, attribute the comment to the student who first gave it. For the instructor who finds learning names difficult, an almost equal effect can be gained from learning any unique identifying information about each student, such as where they are from or where they work.

Encourage students to learn each others' names. At the start of the first few classes, have them introduce themselves to their neighbor. When in small discussion groups, remind them to begin by being sure that everyone knows everyone else's names and follow up when first monitoring the group activity, asking casually if everyone introduced themselves.

3. Include a structured facilitated activity every 2-3 class periods. The activities can build on each other. Start with activities that are more structured and move to those
that are less structured. More structure means that the students will have fewer choices in terms of possible behaviors, and there will be fewer contingencies for the instructor to deal with. Less structure will give students a greater sense of challenge and are valuable for the class that has developed some interactions skills and sense of community.

Examples of activities from higher to lower structure:
1. Providing situation and exploring alternatives, listing them on the board
2. Discussing hypothetical scenarios (what if...?).
3. Structured brainstorming
4. Working through a case study
5. Talking about processes in past experiences - such as details for how to solve a problem, or experiences in a group task (less structure because students provide past experiences)
6. Talking about processes in future experience - planning and anticipating
7. Role playing
8. Whole class building of something or problem solving, where outcome really is ambiguous. Students can see and perform weighing of options, etc.
9. The same in small groups, with reporting out to the group as a whole at the end.
10. Fishbowl activities. The 'fishbowl' technique is to assign a small number of people as participants in an activity that requires interaction, and then to assign one or more other people to act as observers. Observers and participants are not permitted to interact with one another during the activity. Following the activity, the instructor leads a discussion generated by the comments of the observer and the reactions of the participants. An example for computer science would be fishbowl pair programming. While the general outline of the technique is structured, the interaction component has a very high contingency factor that may require some skillful facilitation.

The Instructor as Facilitator

For the purposes of aiding the development of interaction and collaboration in the classroom, facilitation provides an effective balance between providing structure and
allowing student-based interaction and collaboration. The critical element is that the instructor must see the classroom as a system of relationships among the students as well as the instructor, rather than a set of independent relationships between the instructor and each student. This means that the instructor must give up some control of the flow of information within the classroom or the learning of the student.

1. The instructor should develop patterns of behavior that establish his or her identity as facilitator. These include

   a) active guiding of group processes. Listening and responsiveness to emerging group dynamics becomes important. The instructor should be able to modify a lecture or course plan--or to redirect a group back on track in a supportive manner--to respond to how a class period is unfolding.

   b) extended question and answer periods where the instructor prompts students and asks follow up questions.

   c) engaged and supportive facial and body expressions beyond what the instructor might be comfortable with in ordinary conversation. However, care should be taken to always appear genuine.

   d) the explicit communication and enforcement of expectations regarding student interaction. This should be done casually and with confidence, conveying without a doubt that you know students will meet these expectations.

   e) active and genuine engagement in fostering student interaction for both large and small group discussion.

This role will be resisted by students. First, it requires more activity and engagement on the part of the student. Second, it introduces ambiguity and risk.

There are strategies for 'holding fast' to the facilitator role. For example,

   a) don't have the whole of the presentation planned out, but expect to use lectures to generate or flesh out material rather than transmit or relay it,

   b) don't be afraid of silence, don't offer the answer right away, gently 'lead' the students in the reasoning process if necessary,
c) don't debate the students, eliminate the initial impulse to disagree or correct a student's answer. Do not begin response with 'yes, but' - instead use 'perhaps, what about,' or 'yes, and' or 'yes, why?' or 'I'm not sure about that, can you explain that more?' or identify to yourself why they are getting an incorrect answer and then direct such as 'you're missing a step' or 'that would be OK, but there's a better answer given what we've learned'.

d) do not evaluate or judge student responses negatively unless necessary. Instead, invite students to respond to the contribution. Harsh responses can be chided for being so cutting to their comrades. Tentative students can be encouraged to provide criticism in a constructive way. In this manner, the instructor helps students develop communication skills for handling disagreements and other differences of opinion.

2. The instructor should model behaviors of discussion and collaboration. As with effective facilitation, effective discussion and collaboration rests on students acting as though they are part of a system rather than as one of an aggregate of individuals. The instructor can demonstrate how this could be done. For example,

a) redirect student questions so they are answering each other. This should be done in a manner that creates a pace that might be expected in actual conversation.

b) explicitly reflect or otherwise provide metacommunication about working through processes or working in groups. One example is to provide verbal cues, such as 'we've heard two claims that seem incompatible. Let's unpack the assumptions that each of these claims makes to see which one is more reasonable.'

c) use exercises that place the whole class in the role of group solving problem together, with instructor as facilitating the process rather than providing the answer

3. Provide predictable times for collaboration and discussion to present itself in classes. Increase these or make them more challenging over the course of the semester. These times may be in every class period, or in every unit. For example, every 3rd period in a unit could be devoted to some task that involves substantial interaction and
discussion. Or every class period could begin with a question, to be discussed for 3 minutes by neighboring students and then answered in a whole-class facilitated discussion.

4. Attend to each student in terms of how likely or under what conditions they are likely to participate. The goal here is to equalize and individualize expectations for participation. Imposition of imbalanced participation is one of the most significant barriers to collaboration.

Look for students who:

1. don't need prompting (could be good resources for discussions and harder Q&A, but less so for standard Q&A). These should be given supportive cues to hold some of their comments.

2. just need an explicit go-ahead from instructor. These students often signal their readiness with nonverbal cues, such as body language. Call on these students when the cues are exhibited.

3. need encouragement. Attempt to create nonthreatening spaces for these students to participate. Do not consider it 'unfair' to single these students out somewhat more. Nor should encouragement be approached as 'coddling.' The expectation is that students will become more self-reliant and confident to participate on their own.

4. need framing (students who can't see how to do it, or who have cultural barriers to participation). These students may need more 'meta-communication' to make explicit the norms for interaction and communication. This may be the case in classes composed of students from multiple disciplines, where norms for turn-taking may be very different. Another example is the international student from a culture that has quite different interaction norms than those found in U.S. culture.

5. are simply recalcitrant. Many groups have such a person. Minimize the effect by avoiding negative statements or comments about the person. Do not cajole or attempt to ostracize. This violates the principles of safety and community vital to an effective interactive climate.
5. The following components can be used to plan an interaction activity. Each of these should be thought through as part of developing the lesson plan. The purpose is to as fully as possible visualize the activity before it occurs, to more effectively facilitate it:

1. conceiving - set the agenda, determine the objectives
2. anticipating - what are the possible paths, dynamic variations in interaction, what are the best responses to these variations?
3. launching - how to set it up in the classroom, to draw the boundaries of the activity, to get students in the right mindset
4. growing and extracting - handling the unfolding and the contingencies, maintaining path, handling obstreperous students. The instructor needs to maintain an active presence during this phase as well.
5. closing - how the activity should be summarized, what lessons should be pulled out, how to transition to the next activity.