Breadth First Search: A Virtual Experiment

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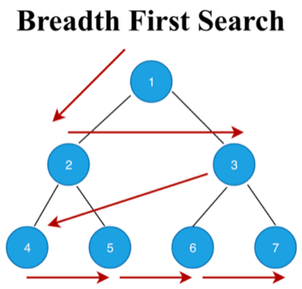
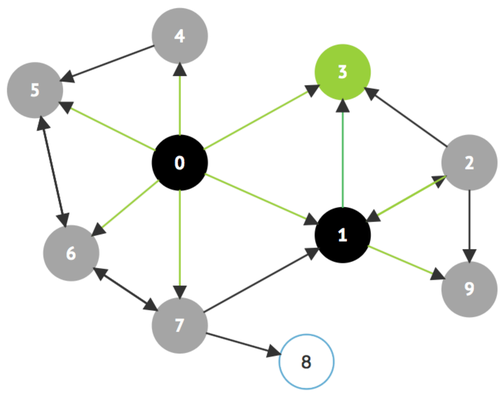
Objective

Our primary goal is to build a full-fledged interactive experiment on one of the essential algorithms in Computer Science - the Breadth First Search algorithm. Learning becomes fairly easy when it is more visual than textual. One of Merrill's design principles states that learning is better when the knowledge is actually demonstrated, rather than merely told. We want to build and develop interactive artefacts to teach and explain this algorithm as eloquently as possible, so that the learner, even if he/she starts from scratch, can understand the concepts well. We want to build a complete experiment, with simulations, videos and quizzes for self evaluation.



Gagné's Nine Events of Instruction

Gagné's event #1	Gain attention of the students
Gagné's event #2	Inform students of the objectives
Gagné's event #3	Stimulate recall of prior learning
Gagné's event #4	Present the content
Gagné's event #5	Provide learning guidance
Gagné's event #6	Elicit performance (practice)
Gagné's event #7	Provide feedback
Gagné's event #8	Assess performance
Gagné's event #9	Enhance retention and transfer to the job



Experiment Evolution

The BFS experiment has been divided into various learning units which are further divided into tasks. These tasks have been developed in accordance to Robert **Gagné's Nine Events of Instruction**.

1. **Introduction**: A complete overview of the experiment, mentioning the learning objectives and pre-requisites. It is essential that the student knows what he/she is going to learn during the course. (***Gagné's event 2***).
2. **Basics**: The Basics learning unit has been divided further into two tasks: one for the queue data structure and the other for the graph data types. The knowledge of these concepts is essential, as the student would not be able to learn and implement the BFS algorithm without it. So we stimulate recall of prior learning (***Gagné's event 3***) and brush up the student's understanding of these concepts with a couple of videos and animations.
3. **The BFS algorithm**: Now that we have introduced the experiment and revised the concepts, we start learning the algorithm. This has been divided into 5 tasks.
   - **Theory**: We first explain about what BFS is, and how it successfully traverses a graph. We then distinguish it from the Depth First Search (DFS) algorithm with the help of an interactive demo.
   - **Applications**: We talk about the complexity of this algorithm and why we really need it - by talking about some applications. (***Gagné's Events 4 and 5***)
   - **Perform BFS**: We now present the learner with two interactive artefacts, where he/she can actually perform a BFS on trees and graphs, abiding by Merrill's 'Demonstrate' instruction. The user can click on the nodes, and see how the graph is traversed at every step, with the nodes changing colours accordingly. The user can either see the whole traversal at once, or even go step by step for better understanding. Hence, we 'Elicit performance'. (***Gagné's event 6***)
   - **BFS using Queues**: Now we move on to how we can actually implement this algorithm using queues. We first explain all the steps and then present a video which demonstrates a complete dry run of the algorithm. We do so in a programming language independent manner, so that the learner understands the concept well. We then have another interactive artefact, where the learner can perform a BFS on the graph and simultaneously see the values in the queue and visited array change. This makes the concept crystal clear.
   - **Quiz**: And finally, we have an exercise and a quiz. The user must perform a BFS on the graph by clicking on the nodes in order. We check if the answer is correct, and then the user can move on to some conceptual MCQ questions. This way, we assess the performance of the learner, abiding by ***Gagné's event 8***.

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http://exp-vlabs.iiit.ac.in/bfs/exp.html