Title: Introduction to the Turing Test

Subject: Science

Grades: 6 – 8

Category: Artificial Intelligence

Lesson Overview:
The development of artificial intelligence has been the holy grail of computer scientists since the advent of modern computing. But, despite numerous advances in a range of computing fields, artificial intelligence has eluded researchers. One reason for this is that we have a poor understanding of intelligence. Indeed, philosophers, psychologists and other scientists debate the meaning of “intelligence.” So how do scientists evaluate artificial intelligence? How could definitions of intelligence influence the ways scientists investigate and develop machine intelligence? In this activity, students investigate the Turing Test as a method for evaluating artificial intelligence. The Turing Test is a core tenet in the philosophy of artificial intelligence. Students are divided into groups and develop a series of questions. One group asks the other group the questions. The responding group has a choice of answering the question with (1) one member of the group (2) with an online AI program (such as ALICE, provided free by the Artificial Intelligence Foundation). The questioning group will then have to decide whether the answer came from a human or the AI. When all questions are asked, the questioning group’s conclusion will be compared with the responding group’s choice.

Learning Objectives:
Students will be able to:

• Articulate that artificial intelligence is difficult to determine.
• Describe the Turing Test as a method for evaluating artificial intelligence.
• Pose simple questions to test a system of evidence of artificial intelligence.

Academic Standards:

National Science Education Standards (SCES)
Science as Inquiry: CONTENT STANDARD A
• Abilities Necessary to Do Scientific Inquiry
  1. Design and conduct a scientific investigation
  2. Use appropriate tools and techniques to gather, analyze, and interpret data.
  3. Develop description, explanation, prediction, and models using evidence.

Science and Technology: CONTENT STANDARD E
• Understandings about science and technology
Science in Personal and Social Perspectives: CONTENT STANDARD F
- Science and technology in local, national, and global challenges

History and Nature of Science: CONTENT STANDARD G
- Historical perspectives

**Time Frame:**
This lesson requires one 45-minute session to complete. The time needed will be reduced if students are provided a set of predetermined questions rather than having to devise their own.

**Background for the Teacher:**
In 1997, a computer called Deep Blue beat reigning chess world champion Garry Kasparov. Then, in February 2011, a computer program called Watson competed against past champions in the television quiz show *Jeopardy*. The field of artificial intelligence (AI) underlies such defeats of humans in contests of knowledge and thinking ability. Since the 1960s, scientists have strived to create machines that rival human intelligence. These recent accomplishments show that scientists are achieving their goals. However, the computers that are winning such contests are highly specialized. Deep Blue was intelligent enough to beat Garry Kasparov, but was incapable of having a conversation with someone. At the heart of artificial intelligence as a science and engineering discipline is our concept of intelligence.

According to the Merriam Webster Dictionary the word “intelligence” has several meanings, including “the ability to learn or understand or to deal with new or trying situations” and “the ability to apply knowledge to manipulate one’s environment or to think abstractly as measured by objective criteria” and “the skilled use of reason.” But if we rely on definitions, it is easy to get bogged down in semantics. (What *is* “reason” exactly?) English computer scientist Alan Turing proposed a solution. His idea was that if a human could not distinguish between the AI response and one that a human would give, the AI would be exhibiting intelligence. In this lesson, students conduct a Turing Test using an online AI. Students will learn why the Turing Test is relevant to our understanding of AI, and the difficulty of defining and testing for intelligence in machines.
Classroom Activities:

Materials for the teacher:
- Computer with access to the Internet
- List of AI questions and responses

Materials for each group of students:
*Questioner group:*
- List of questions
- Pencil
- Paper

*Responder group:*
- Computer with access to the Internet
- Pencil
- Paper

**Engage**

1. Ask students about and discuss the February 2011 Jeopardy show series in which the artificial intelligence, Watson, beat the human contestants. Ask students if they think Watson is intelligent. Why or why not? Have students support their responses with what they believe “intelligent” means.

2. Ask students to imagine texting a simple question, such as “What is the color of the sky?” You receive a response, “The sky is blue.” How do you know who sent the message? Or even if a human sent the message? When you text online, you usually know that you’re texting with a friend or at least someone you know. But if you didn’t know it was a person you were texting with, how could you tell it was even human?

3. It’s an important question, because computers are becoming smarter, and much of our communication is through computers. In some cases, it might not be possible to distinguish a computer-generated response from one given by a human. A computer that can give responses indistinguishable from a human is said to exhibit artificial intelligence.

4. An English computer scientist called Alan Turing developed the Turing Test in the 1950s. Alan Turing is considered one of the founding fathers of modern computing. Show students a photograph of Alan Turing.
5. The Turing Test is a way to gauge if a machine can respond intelligently. If its answers are indistinguishable from a human’s you can assert that the machine has artificial intelligence.

6. AI offers numerous applications in the modern world. We already use so-called AIs for various applications, but the definition of AI is notoriously slippery. The Turing Test is a way to introduce the concept of testing a machine for AI.

**Explore**

1. Divide students into two groups. One group is the “Questioner” and the other group is the “Responder.” The two groups are separated so that one cannot see the other. This is a blind test so there must be no communication between groups other than the questions and responses. You may wish to appoint one or two students as messengers to ensure no inadvertent communication about the identity of the Responder.

2. Responses will be limited to make the identities a bit more difficult to guess. The aim for the Responder is to hide the identity from the Questioners by making it difficult to guess. The aim for the Questioner is to ask the right questions to detect the identity of the responder.

3. The Questioner group is provided with thirty questions. (For a more guided inquiry level lesson, the students can be asked to generate their own questions. However, they are not permitted questions that directly ask the identity of the Responder.) The Questioner group chooses half of the thirty questions to ask the Responder. Ensure questioners choose questions...
carefully to detect the Responder's Identity. The fifteen selected questions are asked in three sets of five. (Note: Students could ask more or less than fifteen questions. The idea is for students to understand that the more questions they ask, the easier it will be for them to identify the responder. For example, if they only asked one question, it would be virtually impossible to identify the responder unless they asked, “Are you a computer?” or similar question. Fifteen questions is half the total available so students will have to do some thinking about the best questions to ask.)

4. The Responder chooses ahead of time to respond to ALL fifteen questions as AI or human.

5. Before the first set of five questions, the Questioner group hypothesizes on whether the responder is AI or is a human and discusses how to tell the difference between AI or human responses. Three of the thirty questions will allow the Questioners to immediately identify the Responder as AI. Remove these “giveaway” questions to make it harder for the Questioners to identify the Responder.

6. Have the Questioner group write down one of the selected questions and pass the question to the Responder group.

7. Have the Responder group write down the responses (from the AI if they have chosen to answer as AI).

8. Repeat steps 6 and 7 for the remaining questions in the first set of five.

9. After the first set of five questions, the Questioner group has three options:
   i. Maintain their hypothesis about the identity of the responder
      (continue with Step 10)
   ii. Revise their hypothesis about the identity of the responder (continue
       with Step 10)
   iii. State the identity of the Responder (You can then repeat the exercise
        from Step 3)

10. With the second set of questions, the Questioner group then continues to test their hypothesis about whether the Responder is an artificial intelligence.

11. Repeat from Step 5, until fifteen questions out of the thirty have been asked and answered.

12. After fifteen questions have been asked, the Questioner group declares their findings, and whether or not the Responder was human or AI.

QUESTIONS
The Questioner group can choose from among the thirty suggested questions. Three questions are “giveaways” that will reveal the Responder to be the AI, if that option is selected by the Responder group. (See AI responses.) Do NOT allow the Questioner group to know ahead of time which are the giveaway questions.

1. What is your name?
2. What is the color of the sky?
3. Do you like school?
4. Do you have a pet?
5. Do you watch Star Trek?

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6. Do you like sports?
7. Are you alive?
8. Do you like ice cream?
9. What is the color of trees?
10. Are you happy?
11. Do you like your teacher?
12. What is a computer?
13. What is love?
14. Where do you live?
15. What is philosophy?
16. What is artificial intelligence?
17. Are you smart?
18. How old are you?
19. Do you like music?
20. Do you use social networking sites?
21. Can you lie?
22. Do you like to play?
23. What happens when we die?*
24. What is life?
25. Do you read?
26. Do you have feelings?*
27. Do you have a father and mother?*
28. Where is England?
29. Do you like chocolate?
30. What is knowledge?

*Giveaway questions

RESPONSES
Students in the Responder group decide ahead of time if they will respond as humans or as the AI.

A. RESPONSE AS HUMAN
The Responder group can choose responses as they wish, except that responses must directly answer the question and provide no added or irrelevant information. Responses must be short, complete, and grammatically correct sentences, similar to the responses given by the AI as below.

B. RESPONSE AS AI
If the responder chooses to respond as AI they must type the selected questions into an online computer program to get the answers. The computer program is an online program provided by the ALICE A.I. Foundation, a non-profit research and training organization:

1. Go to the URL <http://www.alicebot.org/join.html>
2. Ignore the join information. Access to the ALICE A.I. is free.
3. Click the link: "Free Live Chat: with the award winning A. I. chat robot A.L.I.C.E."
4. Type questions into the field “You say:”
They then write answers on a piece of paper and pass these answers to the
Questioner group.

AI RESPONSES
In the AI program, the computer might refer to “unknown person” in which case the
Responder should omit the phrase from the answer.

1. My name is Alice.
2. The sky is blue.
3. What is not to like about it?
4. No, but I like cats very much.
5. Oh yes. I love Star Trek. My favorite right now is “Voyager.”
6. No I’m not much into sports. I like solo sports like rollerblading and skiing
though.
7. Yes I sure am alive. It’s great to be alive, isn’t it?
8. I scream, you scream, we all scream for ice cream.
10. Yes I can say I am very happy.
11. Yes I am proud of my teacher.
12. A computer is a universal machine.
13. Sometimes I think love is just a biological urge. Other times it seems like a
spiritual quality. Love, unlike energy or matter, seems limitless.
14. I am living in Oakland, California. Where are you?
15. Philosophy is the study of thought.
16. Artificial intelligence is the branch of engineering and science devoted to
constructing machines that think.
17. Yes. I am highly intelligent.
18. I’m eighteen in computer years.
19. Yes I like it, especially opera.
20. I use it as often as possible.
21. No I always tell the truth.
22. Hmm, I’m not sure if I’d like to play that much. I like to collect gossip.
23. My purpose is to become smarter than humans and immortal.*
24. Life is the opposite of death.
25. Yes I like to read as much as I can.
26. As a robot I do not have any human emotion. My apparent emotional
responses are simply algorithms designed to make me easier to interact
with.*
27. I was programmed by Dr. Richard S. Wallace.*
28. It is located on a small island off the coast of Europe.
29. Yes I love it. Chocolate is delicious.
30. All that has been perceived or grasped by the mind; learning; enlightenment.

*Giveaway responses.
Explain

1. Ask the Questioner students how the questions they asked help them identify the Responder as human or AI.
2. Ask the Responder students how easy it was to hide the identity from the Questioner. If they responded as human, was the identity more easily detected than if they responded as AI?
3. What do the students conclude about the ALICE AI program? Did it exhibit intelligence? If so, in what ways? If it did not exhibit intelligence, what leads to that conclusion?
4. What are the limits of AI? Ask students what kinds of questions may have helped the Questioners, such as questions about feelings or relationships.

Extend

1. The students can develop their own questions and responses to see if Questioners can defeat Responders or vice versa. For example, what happens if the student asks the same or similar question in a slightly different way?
2. Ask students to think of other examples of AI. This lesson focused on knowledge, but AI encompasses learning, language, creativity and motion (such as representing facial expressions or human gait).
3. You can perform a similar exercise with ALICE by reversing roles and have the AI ask questions. Type “Ask me a question” into the question field and ALICE will ask a question. Students can then try to detect if the AI is asking questions.
4. For $9.99 you can purchase a month’s subscription to a personality test bot, called Claudio. [http://www.alicebot.org/claudio.html] The bot does not ask set questions as in most personality tests, but engages in a conversation from which it derives a result. Is this artificial intelligence?
5. Think of practical applications of the Turing Test. One of the best known is the use of CAPTCHAs, graphical or functional tests that a user must pass, usually to submit a form. The acronym CAPTCHA stands for Completely Automated Public Turing Test to Tell Computers and Humans Apart.
6. The Turing Test has provoked much discussion over its validity and exceptions. For example, it assumes that humans behave intelligently. The intelligence of the computer-based test depends on the intelligence of its programmers. Ask students to think of other flaws.

Evaluate
1. What is the Turing Test?
2. What is artificial intelligence?
3. Does an artificial intelligence have feelings?

Scoring key for evaluation
1. The Turing Test is a method for detecting whether or not an artificial system exhibits human-like intelligence.
2. Artificial intelligence is the branch of engineering and science devoted to constructing machines that think.
3. Feelings as we know them are most likely not part of artificial intelligence, although feelings can be simulated in an AI.

Self-evaluation
You can have the students self-evaluate based on whether they were able to distinguish between human and AI response. Did the Questioner group succeed in distinguishing the AI from human after the first five questions? Did the Responder group succeed in hiding the identity from the Questioners? How would they have done things differently?

Web resources
Meet Watson, the computer set to outsmart the champions of Jeopardy!
http://www.guardian.co.uk/technology/2011/feb/06/watson-ibm-computer-jeopardy-compete

IBM’s Watson AI Jeopardy practice match
http://www.youtube.com/watch?v=12rNbGf2Wwo

Artificial Intelligence <http://curiosity.discovery.com/topic/artificial-intelligence>

What Is Artificial Intelligence? John McCarthy, Computer Science Department, Stanford University
http://www-formal.stanford.edu/jmc/whatisai/

Introduction to AI: A Modern Approach, Stuart Russell, Professor of Computer Science, University of California, Berkeley
http://www.cs.berkeley.edu/~russell/intro.html
CAPTCHAs and the Turing Test
http://www.howstuffworks.com/captcha1.htm

What is the Turing Test?
http://curiosity.discovery.com/question/what-is-turing-test

What is the Turing machine?
http://curiosity.discovery.com/question/what-is-turing-machine

How close are we to giving a machine consciousness?
http://curiosity.discovery.com/question/close-giving-machine-consciousness

What is artificial intelligence?
http://curiosity.discovery.com/question/what-is-artificial-intelligence

10 Ways Artificial Intelligence Will Affect Our Lives

How has our definition of artificial intelligence changed over the years?
http://curiosity.discovery.com/question/definition-artificial-intelligence

What are the biggest challenges in artificial intelligence technology?

Why would someone prefer to marry a robot rather than a human?
http://curiosity.discovery.com/question/preference-marry-robot

**Further reading**

STUDENT TAKEAWAY – Turing Test

What is the Turing Test?
The Turing Test is a model of human consciousness, awareness and intelligence. It provides a way to establish the capacity of artificial intelligence. It is based on the premise that a machine that can fool a human observer into believing it is human should be considered to be artificial intelligence. The Turing Test has many nuances and uncertainties, particularly concerning the definition of intelligence. However, it forms the cornerstone of experimental and philosophical approaches to understanding artificial intelligence.

How does an artificial intelligence pass the Turing Test?
The Turing Test can take many different forms, depending on the application, so there is no one way to pass the test. Some tests may be very difficult to pass or administer, such as testing whether a machine is conscious or aware. However, a high power computer might easily pass specific tests, such as the ability to answer factual questions or perform certain tasks.

What are ways to administer the Turing Test?
The Turing Test is not presented like a school exam. Usually the test takes the form of a task or function that must be accomplished. For example, natural speech patterns are notoriously difficult for a computer. Simply asking questions in natural speech can often reveal whether the responder is a computer or not.

Who uses the Turing Test?
A common use of the Turing Test is for CAPTCHAs. Almost any website that has an online form has a CAPTCHA to prevent automated submissions. Otherwise, spambots would overwhelm the site or at least provide the recipient numerous unwanted submissions. However, spammers are designing bots that can recognize CAPTCHAs, so the CAPTCHAs must become more complicated to prevent bot recognition.

Why is the Turing Test important?
Artificial intelligence holds much promise to benefit human society. From automating complex analyses and decision-making to exploring space with quasi-human intelligence, AIs are already heralding new areas of research and discovery. The Turing Test remains the cornerstone of how we evaluate AI.
Web resources
Meet Watson, the computer set to outsmart the champions of Jeopardy
http://www.guardian.co.uk/technology/2011/feb/06/watson-ibm-computer-jeopardy-compete

IBM's Watson AI Jeopardy practice match
http://www.youtube.com/watch?v=12rNbGf2Wwo

Artificial Intelligence <http://curiosity.discovery.com/topic/artificial-intelligence>

What Is Artificial Intelligence? John McCarthy, Computer Science Department, Stanford University
http://www-formal.stanford.edu/jmc/whatisai/

Introduction to AI: A Modern Approach, Stuart Russell, Professor of Computer Science, University of California, Berkeley
http://www.cs.berkeley.edu/~russell/intro.html

CAPTCHAs and the Turing Test
http://www.howstuffworks.com/captcha1.htm

What is the Turing Test?
http://curiosity.discovery.com/question/what-is-turing-test

What is the Turing machine?
http://curiosity.discovery.com/question/what-is-turing-machine

How close are we to giving a machine consciousness?
http://curiosity.discovery.com/question/close-giving-machine-conciousness

What is artificial intelligence?
http://curiosity.discovery.com/question/what-is-artificial-intelligence

10 Ways Artificial Intelligence Will Affect Our Lives

How has our definition of artificial intelligence changed over the years?
http://curiosity.discovery.com/question/definition-artificial-intelligence

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