Golfer

Gheorghe Tecuci, Xiaohan Ding
Learning Agent Center and Computer Science Department, George Mason University
tecuci@gmu.edu, xding2@masonlive.gmu.edu, http://lac.gmu.edu

1. Introduction

This exercise was adapted from:
Jonathan Osbome, Sibel Erduran, Shirley Simon, *Ideas, Evidence & Argument in Science* (IDEAS), King's College London, 2004, pp. 56-58, https://www.stem.org.uk/elibrary/collection/3308
https://www.stem.org.uk/resources/elibrary/resource/28125/ideas-resources

It considers the situation where a golfer has driven a golf ball and the ball is falling freely onto the green. The students are asked to develop evidence-based argumentations in order to determine the truthfulness of a number of statements. The students will need to have some knowledge of the concepts of force, velocity, distance, weight, air resistance and speed.

Section 2 presents the inquiry and Section 3 presents the corresponding argumentations developed with the sInvestigator system.

sInvestigator may be downloaded from http://lac.gmu.edu/sInvestigator/

The knowledge base containing the argumentation may be downloaded from http://lac.gmu.edu/sInvestigator/CaseStudies.html

2. Inquiry

Which of the following statements are true and which are false?

The only forces are on the ball, once it's been hit by the club, are its weight and air resistance.

The force from the golf club acts on the ball until it stops moving.

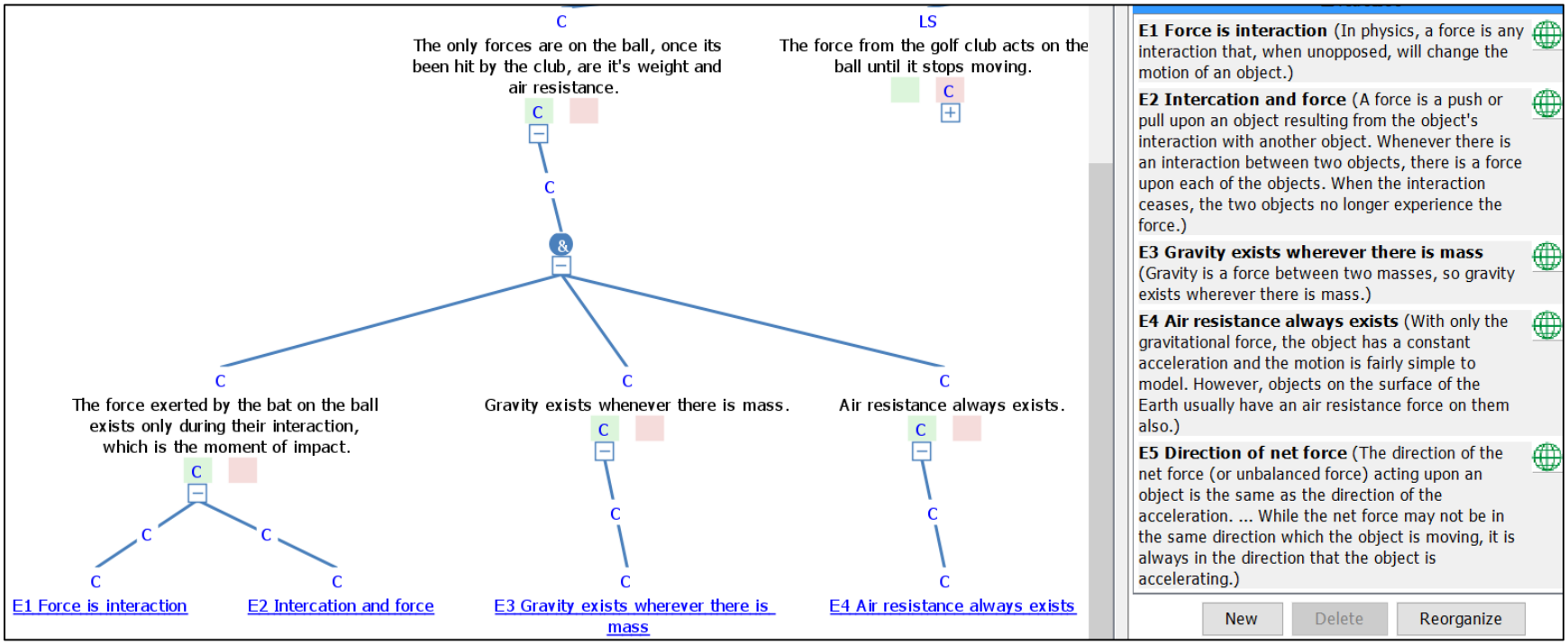
The force which he or she has put into the ball by striking it is being used up as it travels through the air.

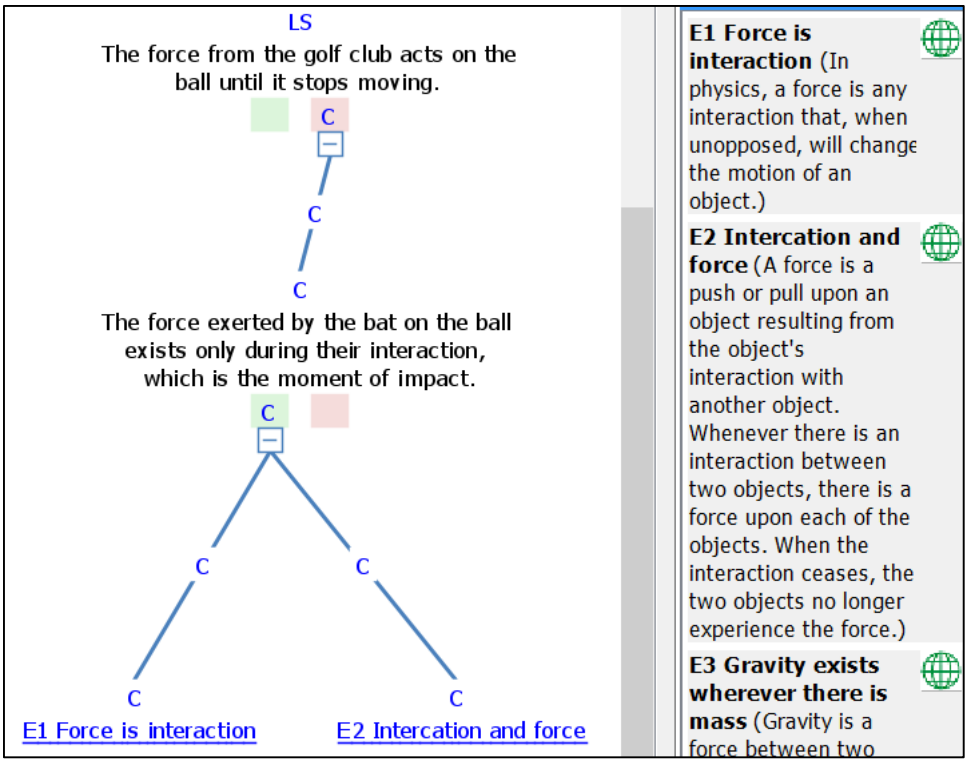
The force from his or her drive wore off at the point where the ball started to drop.

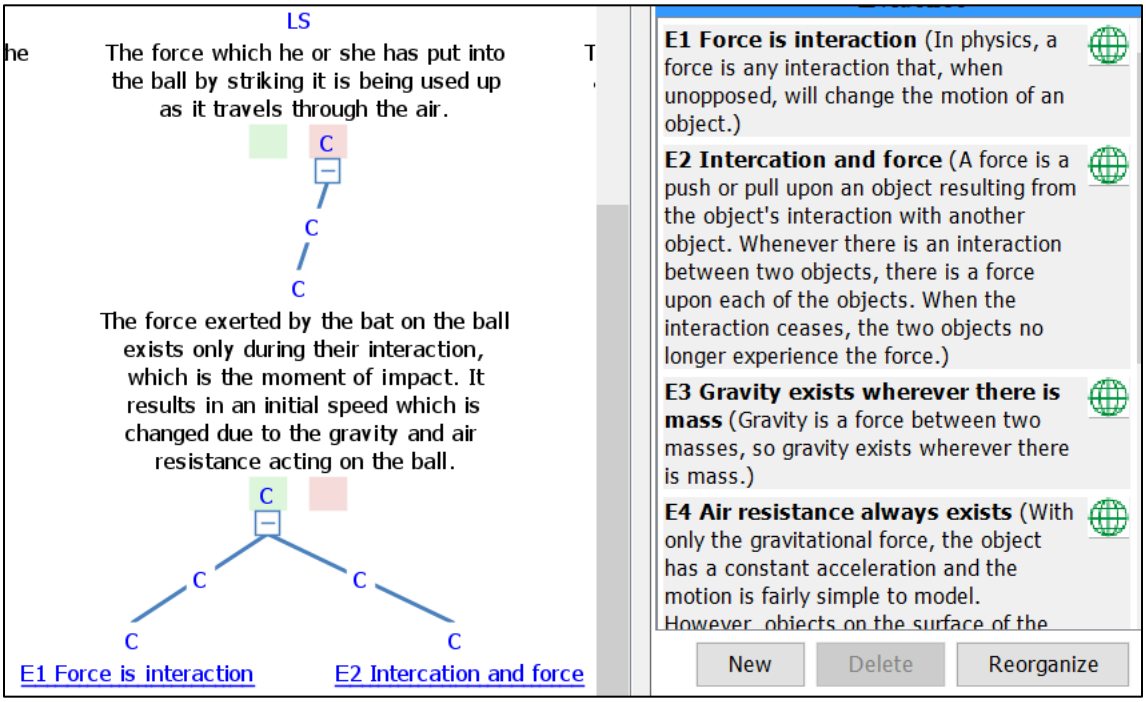
The net force is always in the same direction as the ball is moving.

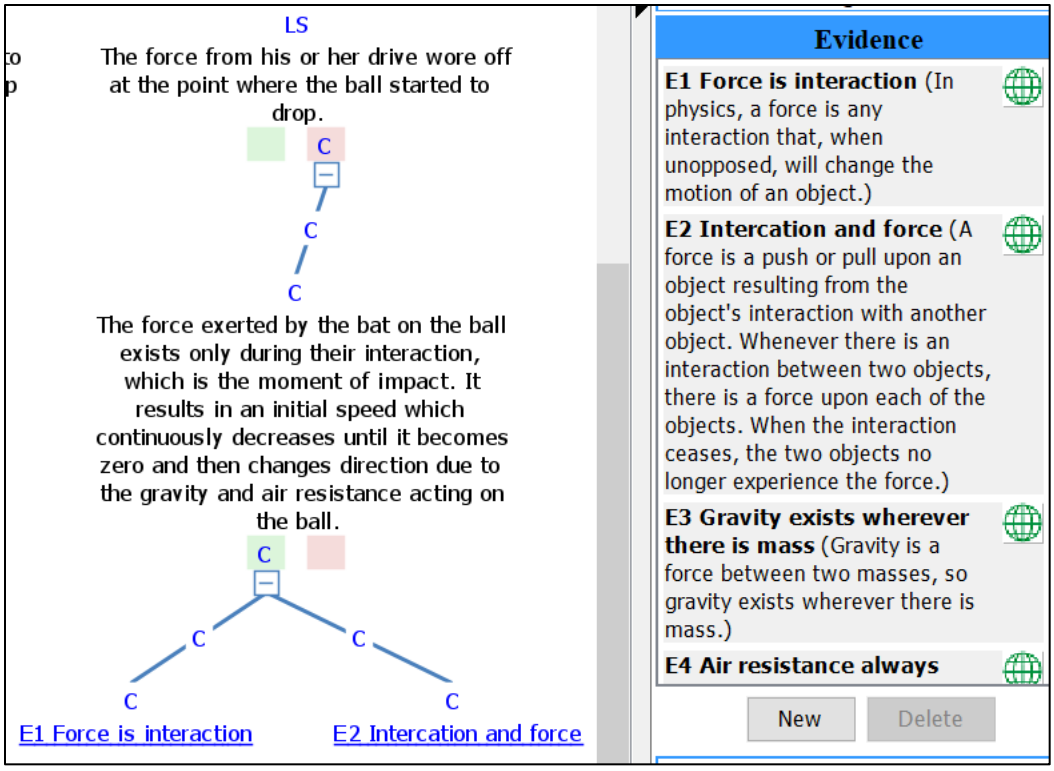
The various forces on the ball can't be thought of as one single net force.

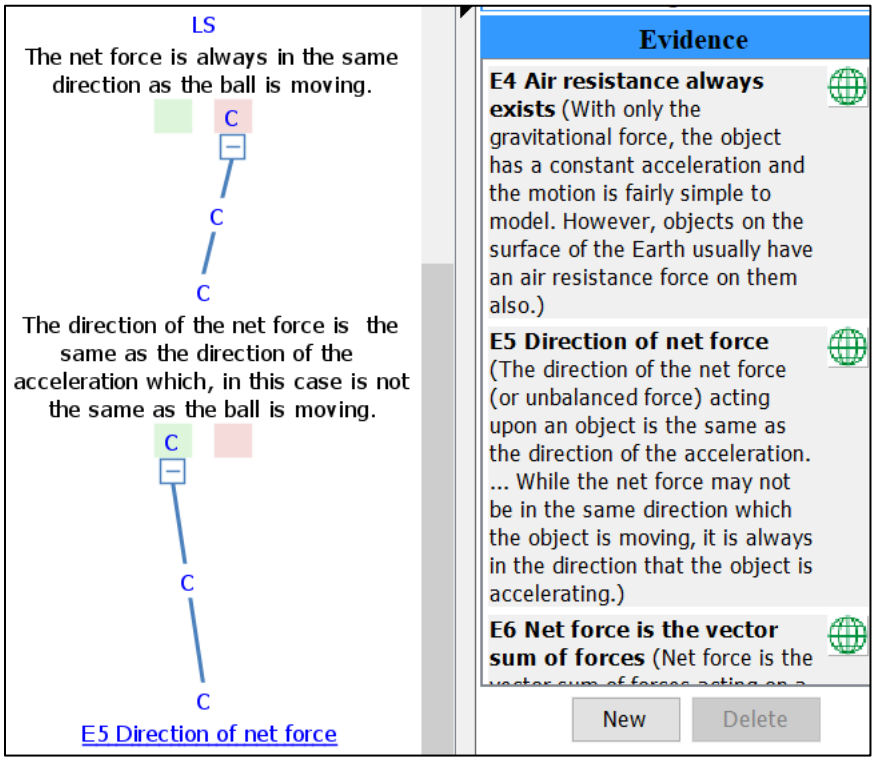
3. Analysis

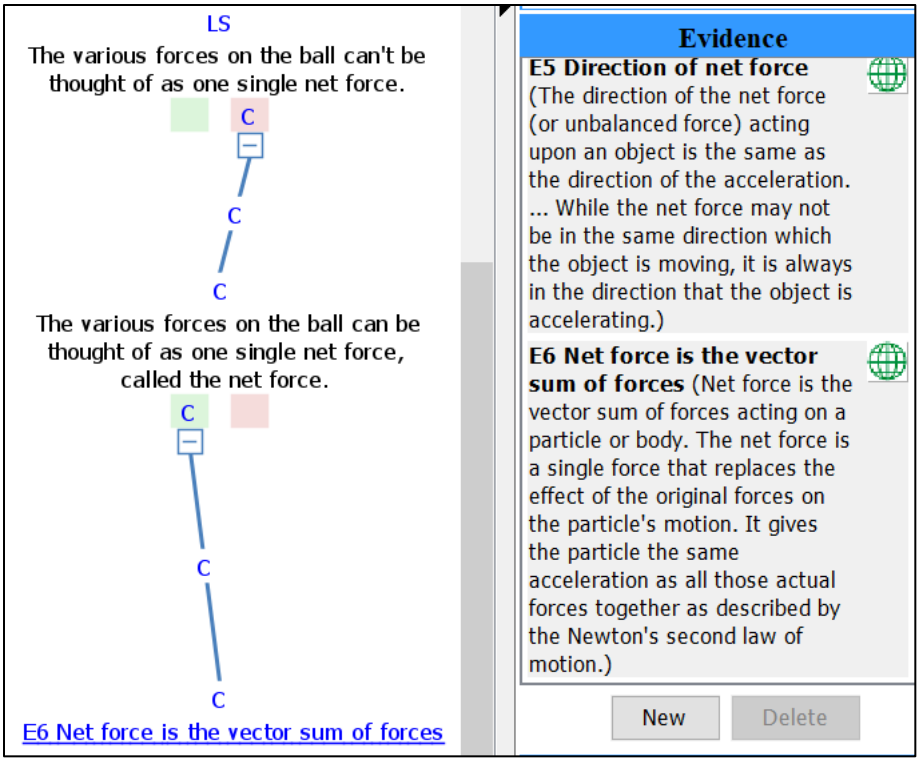

C
The only forces are on the ball, once its been hit by the club, are it's weight and air resistance.
LS
The force from the golf club acts on the ball until it stops moving.
C
C
&
C
The force exerted by the bat on the ball exists only during their interaction, which is the moment of impact.
C
Gravity exists whenever there is mass.
C
Air resistance always exists.
C
C
C
C
C
C
C
C
C
E1 Force is interaction
E2 Intercation and force
E3 Gravity exists wherever there is mass
E4 Air resistance always exists
E1 Force is interaction (In physics, a force is any interaction that, when unopposed, will change the motion of an object.)
E2 Intercation and force (A force is a push or pull upon an object resulting from the object's interaction with another object. Whenever there is an interaction between two objects, there is a force upon each of the objects. When the interaction ceases, the two objects no longer experience the force.)
E3 Gravity exists wherever there is mass (Gravity is a force between two masses, so gravity exists wherever there is mass.)
E4 Air resistance always exists (With only the gravitational force, the object has a constant acceleration and the motion is fairly simple to model. However, objects on the surface of the Earth usually have an air resistance force on them also.)
E5 Direction of net force (The direction of the net force (or unbalanced force) acting upon an object is the same as the direction of the acceleration. ... While the net force may not be in the same direction which the object is moving, it is always in the direction that the object is accelerating.)
New
Delete
Reorganize


LS
The force from the golf club acts on the ball until it stops moving.
C
C
C
The force exerted by the bat on the ball exists only during their interaction, which is the moment of impact.
C
C
C
C
C
E1 Force is interaction
E2 Intercation and force
E1 Force is interaction (In physics, a force is any interaction that, when unopposed, will change the motion of an object.)
E2 Intercation and force (A force is a push or pull upon an object resulting from the object's interaction with another object. Whenever there is an interaction between two objects, there is a force upon each of the objects. When the interaction ceases, the two objects no longer experience the force.)
E3 Gravity exists wherever there is mass (Gravity is a force between two


LS
he
The force which he or she has put into the ball by striking it is being used up as it travels through the air.
T
C
C
C
The force exerted by the bat on the ball exists only during their interaction, which is the moment of impact. It results in an initial speed which is changed due to the gravity and air resistance acting on the ball.
C
C
C
C
C
E1 Force is interaction
E2 Intercation and force
E1 Force is interaction (In physics, a force is any interaction that, when unopposed, will change the motion of an object.)
E2 Intercation and force (A force is a push or pull upon an object resulting from the object's interaction with another object. Whenever there is an interaction between two objects, there is a force upon each of the objects. When the interaction ceases, the two objects no longer experience the force.)
E3 Gravity exists wherever there is mass (Gravity is a force between two masses, so gravity exists wherever there is mass.)
E4 Air resistance always exists (With only the gravitational force, the object has a constant acceleration and the motion is fairly simple to model. However, objects on the surface of the
New
Delete
Reorganize


LS
to
p
The force from his or her drive wore off at the point where the ball started to drop.
C
C
C
The force exerted by the bat on the ball exists only during their interaction, which is the moment of impact. It results in an initial speed which continuously decreases until it becomes zero and then changes direction due to the gravity and air resistance acting on the ball.
C
C
C
C
C
E1 Force is interaction
E2 Intercation and force
Evidence
E1 Force is interaction (In physics, a force is any interaction that, when unopposed, will change the motion of an object.)
E2 Intercation and force (A force is a push or pull upon an object resulting from the object's interaction with another object. Whenever there is an interaction between two objects, there is a force upon each of the objects. When the interaction ceases, the two objects no longer experience the force.)
E3 Gravity exists wherever there is mass (Gravity is a force between two masses, so gravity exists wherever there is mass.)
E4 Air resistance always
New
Delete


LS
The net force is always in the same direction as the ball is moving.
C
C
C
The direction of the net force is the same as the direction of the acceleration which, in this case is not the same as the ball is moving.
C
C
C
E5 Direction of net force
Evidence
E4 Air resistance always exists (With only the gravitational force, the object has a constant acceleration and the motion is fairly simple to model. However, objects on the surface of the Earth usually have an air resistance force on them also.)
E5 Direction of net force (The direction of the net force (or unbalanced force) acting upon an object is the same as the direction of the acceleration. ... While the net force may not be in the same direction which the object is moving, it is always in the direction that the object is accelerating.)
E6 Net force is the vector sum of forces (Net force is the
New
Delete


LS
The various forces on the ball can't be thought of as one single net force.
C
C
C
The various forces on the ball can be thought of as one single net force, called the net force.
C
C
C
E6 Net force is the vector sum of forces
Evidence
E5 Direction of net force (The direction of the net force (or unbalanced force) acting upon an object is the same as the direction of the acceleration. ... While the net force may not be in the same direction which the object is moving, it is always in the direction that the object is accelerating.)
E6 Net force is the vector sum of forces (Net force is the vector sum of forces acting on a particle or body. The net force is a single force that replaces the effect of the original forces on the particle's motion. It gives the particle the same acceleration as all those actual forces together as described by the Newton's second law of motion.)
New
Delete