

## Knowledge Type 9

```
E1 [instance_of: A1, rel11: Y11, ..., rel1k: Y1k]  
and  
...  
and  
En [instance_of: An, reln1: Yn1, ..., relnl: Ynl]  
and  
P1 [instance_of: PROP, is_trait_of: X11, ..., is_trait_of: X1i]  
and  
...  
and  
Pm [instance_of: PROP, is_trait_of: Xm1, ..., is_trait_of: Xmj]  
implies  
X=Y
```

where,  $X, Y \in S_1 \cup S_2$ , such that  $S_1$  is a set of all the entities that participate in events  $E_1, \dots, E_n$  and  $S_2$  is a set of all the entities that are associated with the properties  $P_1, \dots, P_m$ . Also,  $X$  and  $Y$  are associated with different events/properties. Intuitively, a statement of the above category means that if a set ( $S$ ) of events and properties exist together then an entity that is associated with an event  $E$  or property  $P$  in  $S$  is also associated with a different event/property in  $S$ .

### Examples from the Winograd Schema Challenge corpus:

1. The fish ate the worm. It was tasty. What was tasty?

**Correct Answer:** The worm

#### **Knowledge Instance:**

```
P [instance_of: tasty, is_trait_of: X [instance_of: entity]]  
and  
E [instance_of: eat, patient: Y [instance_of: entity]]  
implies  
X=Y
```

2. The fish ate the worm. It was hungry. What was hungry?

**Correct Answer:** the fish.

**Knowledge Instance:**

P [instance\_of: hungry, is\_trait\_of: X [instance\_of: entity]]

**and**

E [instance\_of: eat, agent: Y [instance\_of: entity]]

**implies**

X=Y

3. Joan made sure to thank Susan for all the help she had received. Who had received help?

**Correct Answer:** Joan.

**Knowledge Instance:**

E1 [instance\_of: receive, agent: X [instance\_of: person, instance\_of: entity], theme: Z [instance\_of: help, instance\_of: entity]]

**and**

E2 [instance\_of: thank, agent: Y [instance\_of: person, instance\_of: entity]]

**implies**

X=Y

4. Joan made sure to thank Susan for all the help she had given. Who had given help?

**Correct Answer:** Susan.

**Knowledge Instance:**

E1 [instance\_of: give, agent: X [instance\_of: person, instance\_of: entity], theme: Z [instance\_of: help, instance\_of: entity]]

**and**

E2 [instance\_of: thank, theme: Y [instance\_of: person, instance\_of: entity]]

**implies**

X=Y

5. Tom threw his schoolbag down to Ray after he reached the top of the stairs. Who reached the top of the stairs?

**Correct Answer:** Tom.

**Knowledge Instance:**

E1 [instance\_of: reach, agent: X [instance\_of: entity], recipient: Z [instance\_of: top, instance\_of: entity]]

**and**

E2 [instance\_of: throw, agent: Y [instance\_of: entity], direction: W [instance\_of: down,

instance\_of: entity]]

**implies**

X=Y

**Similarly, following are the other example in this category:**

6. Bob paid for Charlie's college education. He is very generous. Who is generous?

**Correct Answer:** Bob.

7. Bob collapsed on the sidewalk. Soon he saw Carl coming to help. He was very ill. Who was ill?

Correct Answer: Bob.

8. Paul tried to call George on the phone, but he wasn't successful. Who was not successful?

Correct Answer: Paul

9. Steve follows Fred's example in everything. He influences him hugely. Who is influenced?

Correct Answer: Steve.

10. In the storm, the tree fell down and crashed through the roof of my house. Now, I have to get it removed What has to be removed?

Correct Answer: The tree.

11. Madonna fired her trainer because she couldn't stand her boyfriend. Who couldn't stand?  
Answer: Madonna

12. The scientists are studying three species of fish that have recently been found living in the Indian Ocean. They appeared two years ago. Who or what appeared two years ago?

Correct Answer: The fish.

13. Bob paid for Charlie's college education. He is very grateful. Who is grateful?

Correct Answer: Charlie.

14. Steve follows Fred's example in everything. He influences him hugely. Who influences?

Correct Answer: Fred.

15. Steve follows Fred's example in everything. He admires him hugely. Who is admired?

Correct Answer: Fred.

16. Steve follows Fred's example in everything. He admires him hugely. Who admires?  
Correct Answer: Steve.
17. Jane knocked on Susan's door, but there was no answer. She was disappointed. Who was disappointed?  
Correct Answer: Jane.
18. Joe paid the detective after he delivered the final report on the case. Who delivered the final report?  
Correct Answer: detective.
19. I took the water bottle out of the backpack so that it would be lighter. What would be lighter?  
Correct Answer: The backpack.
20. The foxes are getting in at night and attacking the chickens. They have gotten very nervous. What has gotten nervous?  
Correct Answer: the chickens.
21. Bob collapsed on the sidewalk. Soon he saw Carl coming to help. He was very concerned. Who was concerned?  
Correct Answer: Carl.
22. Many people start to read Paul's books and can't put them down. They are gripped because Paul writes so well. Who or what are gripped?  
Correct Answer: The readers.
23. As Ollie carried Tommy up the long winding steps, his legs ached. Whose legs ached?  
Correct Answer: Ollie
24. Bob paid for Charlie's college education, but now Charlie acts as though it never happened. He is very ungrateful. Who is ungrateful?  
Correct Answer: Charlie
25. Thomson visited Cooper's grave in 1765. At that date he had been travelling for five years. Who had been travelling for five years?  
Correct Answer: Thomson
26. The woman held the girl against her chest. Whose chest?  
Correct Answer: The woman's

27. The woman held the girl against her will. Whose will?  
Correct Answer: the girl's
28. Sam Goodman's biography of the Spartan general Xenophanes conveys a vivid sense of the difficulties he faced in his childhood. Who faced difficulties?  
Correct Answer: Xenophanes  
Comment: It is quite possible that "biography" is correlated with "research". But even if that correlation is detected, there is another non-trivial step to realize that the research is associated with the author rather than the subject of the biography.
29. Sam Goodman's biography of the Spartan general Xenophanes conveys a vivid sense of the difficulties he faced in his research. Who faced difficulties?  
Correct Answer: Sam.  
Comment: It is quite possible that "biography" is correlated with "research". But even if that correlation is detected, there is another non-trivial step to realize that the research is associated with the author rather than the subject of the biography.
30. The father carried the sleeping boy in his arms. Whose arms?  
Correct Answer: The father  
Comment: The concern has been raised that there may be a statistical association between "sleeping boy" and "bassinet".
31. The father carried the sleeping boy in his bassinet. Whose bassinet?  
Correct Answer: the boy  
Comment: The concern has been raised that there may be a statistical association between "sleeping boy" and "bassinet".
32. Stretching her back, the woman smiled at the girl. Whose back did the woman stretch?  
Correct Answer: the woman's
33. The man lifted the boy onto his shoulders. Whose shoulders?  
Correct Answer: the man's.
34. Alice tried frantically to stop her daughter from barking at the party, leaving us to wonder why she was behaving so strangely. Who was behaving strangely?  
Correct Answer: Alice's daughter.
35. Dr. Adams informed Kate that she had cancer and presented several options for future treatment. Who had cancer?  
Correct Answer: Kate
36. Sam's drawing was hung just above Tina's and it did look much better with another one below it. Which looked better?

Correct Answer: Sam's drawing.

37. Sam's drawing was hung just above Tina's and it did look much better with another one above it. Which looked better?

Correct Answer: Tina's drawing.

38. The foxes are getting in at night and attacking the chickens. I shall have to guard them. What do I have to guard?

Correct Answer: The chickens.

39. Jane knocked on Susan's door but she did not get an answer. Who did not get an answer?

Correct Answer: Jane

Comment: Simplified version of #69. Like #69, it relies on textual coherence for disambiguation; it is, after all, equally true that Jane did not answer, and that Susan did not get an answer.

40. Jane knocked on Susan's door but she did not answer. Who did not answer?

Correct Answer: Susan

Comment: Simplified version of #69. Like #69, it relies on textual coherence for disambiguation; it is, after all, equally true that Jane did not answer, and that Susan did not get an answer.

41. The police arrested all of the gang members. They were trying to run the drug trade in the neighborhood. Who was trying to run the drug trade?

Correct Answer: The gang.

Comment: Hopefully the reader is not too cynical.

42. If the con artist has succeeded in fooling Sam, he would have lost a lot of money. Who would have lost the money?

Correct Answer: Sam.

43. Fred watched TV while George went out to buy groceries. After an hour he got back. Who got back?

Correct Answer: George.

44. Anne gave birth to a daughter last month. She is a very charming baby. Who is a very charming baby?

Correct Answer: Anne's daughter.

45. The cat was lying by the mouse hole waiting for the mouse, but it was too impatient. What was too impatient?

Correct Answer: the cat.

46. Sid explained his theory to Mark but he couldn't understand him. Who was not understood ?

Correct Answer: Sid

47. The foxes are getting in at night and attacking the chickens. I shall have to kill them. What do I have to kill?

Correct Answer: the foxes.

48. Joe has sold his house and bought a new one a few miles away. He will be moving out of it on Thursday. Which house will he be moving out of?

Correct Answer: The old house

49. In the storm, the tree fell down and crashed through the roof of my house. Now, I have to get it repaired. What has to be repaired?

Correct Answer: the roof.

50. John hired Bill to take care of him. Who is taken care of?

Correct Answer: John.

51. Dan had to stop Bill from toying with the injured bird. He is very cruel. Who is cruel?

Correct Answer: Bill

52. As Ollie carried Tommy up the long winding steps, his legs dangled. Whose legs dangled?

Correct Answer: Tommy

53. The delivery truck zoomed by the school bus because it was going so fast. What was going so fast?

**Correct Answer:** The truck

54. Joe has sold his house and bought a new one a few miles away. He will be moving into it on Thursday. Which house will he be moving into?

**Correct Answer:** the new house.

55. Lily spoke to Donna, breaking her concentration. Whose concentration?

**Correct Answer:** Donna

56. Lily spoke to Donna, breaking her silence. Whose silence?

**Correct Answer:** Lily

57. Anne gave birth to a daughter last month. She is a very charming woman. Who is a very charming woman?

**Correct Answer:** Anne.

58. The police arrested all of the gang members. They were trying to stop the drug trade in the neighborhood. Who was trying to stop the drug trade?

**Correct Answer:** the police.

**Comment:** Hopefully the reader is not too cynical.

59. The lawyer asked the witness a question, but he was reluctant to repeat it . Who was reluctant to repeat the question?

**Correct Answer:** the lawyer.

60. Tom's daughter Eva is engaged to Dr. Stewart, who is his partner. The two doctors have known one another for ten years. Which two people have known one another for ten years?

**Correct Answer:** Tom and Dr. Stewart

61. Tom's daughter Eva is engaged to Dr. Stewart, who is his partner. The two lovers have known one another for ten years. Which two people have known one another for ten years?

**Correct Answer:** Eva and Dr. Stewart.

**Comment:** Winograd schema in the broad sense, since there is no ambiguous pronoun.