An Event-B Specification of Fighting
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CONTEXT Fighting
EXTENDS Ranking
CONSTANTS

beatRank The fighting result by rank of hand 1 and hand 2.
beat The final fighting result of hand 1 and hand 2.
validFighting Check the two hand are valid or not to fighting.

AXIOMS

validFighting_D : $validFighting \in \mathbb{P}(SetID) \times \mathbb{P}(SetID) \rightarrow BOOL$

Check the unique of two sets of cards.

validFighting_F : $\forall a, b \cdot \exists c \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land c \in \mathbb{P}(SetID)$
$\land\ isHand(a) = TRUE \land isHand(b) = TRUE$
$\land\ c = a \cup b \land isUnique(c) = TRUE$
$\Rightarrow validFighting(a \mapsto b) = TRUE$

If the set of cards which is composed of a and b is unique, then a and b are valid to fighting.
return TRUE

beatRank_D : $beatRank \in \mathbb{P}(SetID) \times \mathbb{P}(SetID) \rightarrowtail result$

The fighting result by rank of hand 1 and hand 2.

beatRank_F00 : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID)$
$\land\ validFighting(a \mapsto b) = FALSE$
$\Rightarrow beatRank(a \mapsto b) = -1$

If the fighting is not regular,then there is error.
return -1

beatRank_F1 : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land validFighting(a \mapsto b) = TRUE$
$\land\ getRank(a) > getRank(b)$
$\Rightarrow beatRank(a \mapsto b) = 1$

If the rank of a is bigger than the rank of b, then a win b.
return 1

beatRank_F2 : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land validFighting(a \mapsto b) = TRUE$
$\land\ getRank(a) < getRank(b)$
$\Rightarrow beatRank(a \mapsto b) = 2$

If the rank of a is less than the rank of b, then b win a.
return 2

beatRank_F0 : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land validFighting(a \mapsto b) = TRUE$
$\land\ getRank(a) = getRank(b)$
$\Rightarrow beatRank(a \mapsto b) = 0$

If the rank of a is equal to the rank of b, then a equal b.
return 0.

beat_D : $beat \in \mathbb{P}(SetID) \times \mathbb{P}(SetID) \rightarrowtail result$

The final fighting result.

beat_F00 : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) \neq 0$
$\Rightarrow beat(a \mapsto b) = beatRank(a \mapsto b)$

If the rank of a is different from the rank of b, or the fighting is not regular, then return the result of fighting.

beat_Royal : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 10 \Rightarrow beat(a \mapsto b) = 0$

If a and b have the same rank and is 10 (Royal Flush), then a equal b. return 0

beat_StraightFlush : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 9 \Rightarrow beat(a \mapsto b) = compareSetCard(getMax\_Card(a) \mapsto getMax\_Card(b))$

If a and b have the same rank and is 9 (StraightFlush), then the result of beating is the result of comparison between the max card of a with the max card of b.

beat_Four : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 8 \Rightarrow beat(a \mapsto b) = compareSetCard(getThree(a) \mapsto getThree(b))$

If a and b have the same rank and is 8 (Four of a kind), then the result of beating is the result when comparing the value of the four of a with the value of the four of b.

beat_FullHouse : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 7 \Rightarrow beat(a \mapsto b) = compareSetCard(getThree(a) \mapsto getThree(b))$

If a and b have the same rank and is 7 (Full house), then the result of fighting is the result when comparing the value of the three of a with the value of the three of b.

beat_Three : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 4 \Rightarrow beat(a \mapsto b) = compareSetCard(getThree(a) \mapsto getThree(b))$

If a and b have the same rank and is 4 (Three of a kind), then the result of fighting is the result when comparing the value of the three of a with the value of the three of b.

beat_Straight : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 6 \Rightarrow beat(a \mapsto b) = compareSetCard(a \mapsto b)$

If a and b have the same rank and is 6 (Straight), then the result of fighting is the result when comparing the set a with the set b.

beat_Flush : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 5 \Rightarrow beat(a \mapsto b) = compareSetCard(a \mapsto b)$

If a and b have the same rank and is 5 (Flush), then the result of fighting is the result when comparing the set a with the set b.

beat_High : $\forall a, b \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land beatRank(a \mapsto b) = 0 \land getRank(a) = 1 \Rightarrow beat(a \mapsto b) = compareSetCard(a \mapsto b)$

If a and b have the same rank and is 1 (High card), then the result of fighting is the result when comparing the set a with the set b.

beat_TwoPair1 : $\forall a, b \cdot \exists c, d, e, f, g, h \cdot$
$a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land c \in \mathbb{P}(SetID) \land d \in \mathbb{P}(SetID)$
$\land e \in \mathbb{P}(SetID) \land f \in \mathbb{P}(SetID) \land g \in \mathbb{P}(SetID) \land h \in \mathbb{P}(SetID)$
$\land beatRank(a \mapsto b) = 0 \land getRank(a) = 3$
$\land c = getPair(a) \land d = getPair(a \setminus c)$
$\land e = getPair(b) \land f = getPair(b \setminus e)$
$\land g = a \setminus (c \cup d) \land h = b \setminus (e \cup f)$
$\land compareSetCard(c \cup d \mapsto e \cup f) = 0$
$\Rightarrow beat(a \mapsto b) = compareSetCard(g \mapsto h)$

If a and b have the same rank and is 3 (Two pair),
and the two pairs of a are the same value with two pairs of b,
then the winner is the hand has the last card with the value higher.

beat_TwoPair2 : $\forall a, b \cdot \exists c, d, e, f, g, h$
$\cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land c \in \mathbb{P}(SetID) \land d \in \mathbb{P}(SetID)$
$\land e \in \mathbb{P}(SetID) \land f \in \mathbb{P}(SetID) \land g \in \mathbb{P}(SetID) \land h \in \mathbb{P}(SetID)$
$\land beatRank(a \mapsto b) = 0 \land getRank(a) = 3$
$\land c = getPair(a) \land d = getPair(a \setminus c)$
$\land e = getPair(b) \land f = getPair(b \setminus e)$
$\land g = a \setminus (c \cup d) \land h = b \setminus (e \cup f)$
$\land compareSetCard(c \cup d \mapsto e \cup f) \neq 0$
$\Rightarrow beat(a \mapsto b) = compareSetCard(c \cup d \mapsto e \cup f)$

If a and b have the same rank and is 3 (Two pair),
and the two pairs a and two pairs of b are different,
then the winner is the hand has the value of a pair higher.

beat_OnePair1 : $\forall a, b \cdot \exists c, d, e, f \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID)$
$\land c \in \mathbb{P}(SetID) \land d \in \mathbb{P}(SetID) \land e \in \mathbb{P}(SetID) \land f \in \mathbb{P}(SetID)$
$\land beatRank(a \mapsto b) = 0 \land getRank(a) = 2$
$\land c = getPair(a) \land d = a \setminus c$
$\land e = getPair(b) \land f = b \setminus e$
$\land compareSetCard(c \mapsto e) = 0$
$\Rightarrow beat(a \mapsto b) = compareSetCard(d \mapsto f)$

If a and b have the same rank and is 2 (Pair),
and pair of a is the same value with pair os b,
then the result of fighting is the result when comparing
the rest of cards of a with the rest of cards of b.

beat_OnePair2 : $\forall a, b \cdot \exists c, d, e, f \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID)$
$\land c \in \mathbb{P}(SetID) \land d \in \mathbb{P}(SetID) \land e \in \mathbb{P}(SetID) \land f \in \mathbb{P}(SetID)$
$\land beatRank(a \mapsto b) = 0 \land getRank(a) = 2$
$\land c = getPair(a) \land d = a \setminus c$
$\land e = getPair(b) \land f = b \setminus e$
$\land compareSetCard(c \mapsto e) \neq 0$
$\Rightarrow beat(a \mapsto b) = compareSetCard(c \mapsto e)$

If a and b have the same rank and is 2 (Pair),
and pair of a is difference to pair of b,
then the winner is the hand has the pair with the value higher.

beat_Bonus : $\forall a, b, c \cdot a \in \mathbb{P}(SetID) \land b \in \mathbb{P}(SetID) \land c \in \mathbb{P}(SetID)$
$\land beat(a \mapsto b) = 1 \land beat(b \mapsto c) = 1$
$\land validFighting(a \mapsto c) = TRUE$
$\Rightarrow beat(a \mapsto c) = 1$

If a win b and b win c, then a win c.

END