Equation 1 Verification Results

Equation:

[[p]] = [s ∈ W : v(s)(p) = true] where P =p1n:

This equation defines the semantics of atomic propositions in CTL. Computed [[p]] = p = {0, 5, 7}

Results:

P	Q	Computed	Manually Computed	Holds
		{0, 5, 7}	{0, 5, 7}	YES
		{1, 3, 6, 8}	{1, 3, 6, 8}	YES
		{2, 4}	{2, 4}	YES
		{0, 1, 2}	{0, 1, 2}	YES
		{3, 4, 5, 6}	{3, 4, 5, 6}	YES
		{7, 8}	{7, 8}	YES

For more details, see the [log file].

Equation 2 Verification Results

Equation:

[[¬P]] = W \ [[P]] where P = p1n:

This equation defines the semantics of negation in CTL. Computed [[¬P]] = not P = {1, 2, 3, 4, 6, 8}

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{1, 2, 3, 4, 6, 8}	{1, 2, 3, 4, 6, 8}	YES
p1t		{0, 2, 4, 5, 7}	{0, 2, 4, 5, 7}	YES
p1c		{0, 1, 3, 5, 6, 7, 8}	{0, 1, 3, 5, 6, 7, 8}	YES
p2n		{3, 4, 5, 6, 7, 8}	{3, 4, 5, 6, 7, 8}	YES
p2t		{0, 1, 2, 7, 8}	{0, 1, 2, 7, 8}	YES
p2c		{0, 1, 2, 3, 4, 5, 6}	{0, 1, 2, 3, 4, 5, 6}	YES

For more details, see the [log file].

Equation 3 Verification Results

Equation:

[[P ▯ Q]] = [[P]] ∩ [[Q]] where P = p1n, Q = p2n:

This equation defines the semantics of conjunction in CTL. Computed [[P ▯ Q]] = P ▯ Q = {0}

Results:

P	Q	Computed	Manually Computed	Holds
p1n	p2n	{0}	{0}	YES
p1n	p2t	{5}	{5}	YES
p1n	p2c	{7}	{7}	YES
p1t	p2n	{1}	{1}	YES
p1t	p2t	{3, 6}	{3, 6}	YES
p1t	p2c	{8}	{8}	YES
p1c	p2n	{2}	{2}	YES
p1c	p2t	{4}	{4}	YES
p1c	p2c	{}	{}	YES

For more details, see the log file.

Equation 4 Verification Results

Equation:

[[P ▯ Q]] = [[P]] ▯ [[Q]] where P = p1n, Q = p2n:

This equation defines the semantics of disjunction in CTL. Computed [[P ▯ Q]] = P ▯ Q = {0, 1, 2, 5, 7}

Results:

P	Q	Computed	Manually Computed	Holds
p1n	p2n	{0, 1, 2, 5, 7}	{0, 1, 2, 5, 7}	YES
p1n	p2t	{0, 3, 4, 5, 6, 7}	{0, 3, 4, 5, 6, 7}	YES
p1n	p2c	{0, 5, 7, 8}	{0, 5, 7, 8}	YES
p1t	p2n	{0, 1, 2, 3, 6, 8}	{0, 1, 2, 3, 6, 8}	YES

p1t	p2t	{1, 3, 4, 5, 6, 8}	{1, 3, 4, 5, 6, 8}	YES
p1t	p2c	{1, 3, 6, 7, 8}	{1, 3, 6, 7, 8}	YES
p1c	p2n	{0, 1, 2, 4}	{0, 1, 2, 4}	YES
p1c	p2t	{2, 3, 4, 5, 6}	{2, 3, 4, 5, 6}	YES
p1c	p2c	{2, 4, 7, 8}	{2, 4, 7, 8}	YES

For more details, see the log file.

Equation 5 Verification Results

Equation:

[[EX P]] = τEX([[P]]) where P = p1n:

This equation defines the semantics of the existential next operator in CTL. τEX(Z) = {s W : t Z for some state t with s y t}

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{0, 2, 4, 5, 7, 8}	{0, 2, 4, 5, 7, 8}	YES
p1t		{0, 1, 3, 5, 6}	{0, 1, 3, 5, 6}	YES
p1c		{1, 2, 3}	{1, 2, 3}	YES
p2n		{0, 1, 2, 7}	{0, 1, 2, 7}	YES
p2t		{0, 1, 2, 3, 4, 5}	{0, 1, 2, 3, 4, 5}	YES
p2c		{5, 6, 8}	{5, 6, 8}	YES

For more details, see the log file.

Equation 6 Verification Results

Equation:

[[AX P]] = τAX([[P]]) where P = p1n:

This equation defines the semantics of the universal next operator in CTL. τAX(Z) = {s W : t Z for all states t with s y t}

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{4, 7, 8}	{4, 7, 8}	YES

p1t		{6}	{6}	YES
p1c		{}	{}	YES
p2n		{7}	{7}	YES
p2t		{3, 4}	{3, 4}	YES
p2c		{6, 8}	{6, 8}	YES

For more details, see the [log file].

Equation 7 Verification Results

Equation:

[[EF P]] = μZ.([[P]] ▯ τEX(Z)) where P = p1n:

This equation defines the semantics of the existential finally operator using a least fixpoint. μZ.f(Z) denotes the least fixpoint of the operation f(Z).

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p1t		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p1c		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p2n		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p2t		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p2c		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES

For more details, see the [log file].

Equation 8 Verification Results

Equation:

[[EG P]] = νZ.([[P]] ∩ τEX(Z)) where P = p1n:

This equation defines the semantics of the existential globally operator using a greatest fixpoint. νZ.f(Z) denotes the greatest fixpoint of the operation f(Z).

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{0, 5, 7}	{0, 5, 7}	YES

p1t		{}	{}	YES
p1c		{}	{}	YES
p2n		{0, 1, 2}	{0, 1, 2}	YES
p2t		{}	{}	YES
p2c		{}	{}	YES

For more details, see the log file.

Equation 9 Verification Results

Equation:

[[AF P]] = μZ.([[P]] ∪ τAX(Z)) where P = p1n:

This equation defines the semantics of the always finally operator using a least fixpoint. μZ.f(Z) denotes the least fixpoint of the operation f(Z).

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p1t		{1, 3, 6, 8}	{1, 3, 6, 8}	YES
p1c		{2, 4}	{2, 4}	YES
p2n		{0, 1, 2, 3, 4, 5, 6, 7, 8}	{0, 1, 2, 3, 4, 5, 6, 7, 8}	YES
p2t		{3, 4, 5, 6}	{3, 4, 5, 6}	YES
p2c		{3, 4, 5, 6, 7, 8}	{3, 4, 5, 6, 7, 8}	YES

For more details, see the log file.

Equation 10 Verification Results

Equation:

[[AG P]] = νZ.([[P]] ∩ τAX(Z)) where P = p1n:

```
This equation defines the semantics of the always globally operator using a greatest
fixpoint.     νZ.f(Z) denotes the greatest fixpoint of the operation f(Z).
```

Results:

P	Q	Computed	Manually Computed	Holds
p1n		{}	{}	YES

p1t		{}	{}	YES
p1c		{}	{}	YES
p2n		{}	{}	YES
p2t		{}	{}	YES
p2c		{}	{}	YES

For more details, see the log file.

Equation 11 Verification Results

Equation:

[[EP UQ]] = μZ.([[Q]] ∪ ([[P]] ∩ τEX(Z))) where P = p1n, Q = p2n:

```
This equation defines the semantics of the existential until operator using a least fixpoint.     μZ.f(Z) denotes the least fixpoint of the operation f(Z).
```

Results:

P	Q	Computed	Manually Computed	Holds
p1n	p2n	{0, 1, 2, 5, 7}	{0, 1, 2, 5, 7}	YES
p1n	p2t	{0, 3, 4, 5, 6, 7}	{0, 3, 4, 5, 6, 7}	YES
p1n	p2c	{0, 5, 7, 8}	{0, 5, 7, 8}	YES
p1t	p2n	{0, 1, 2}	{0, 1, 2}	YES
p1t	p2t	{1, 3, 4, 5, 6}	{1, 3, 4, 5, 6}	YES
p1t	p2c	{1, 3, 6, 7, 8}	{1, 3, 6, 7, 8}	YES
p1c	p2n	{0, 1, 2}	{0, 1, 2}	YES
p1c	p2t	{2, 3, 4, 5, 6}	{2, 3, 4, 5, 6}	YES
p1c	p2c	{7, 8}	{7, 8}	YES

For more details, see the log file.

Equation 12 Verification Results

Equation:

[[AP UQ]] = μZ.([[Q]] ∪ ([[P]] ∩ τAX(Z))) where P = p1n, Q = p2n:

```
This equation defines the semantics of the universal until operator using a least fixpoint.     μZ.f(Z) denotes the least fixpoint of the operation f(Z).
```

Results:

P	Q	Computed	Manually Computed	Holds
p1n	p2n	{0, 5, 7}	{0, 1, 2, 7}	NO
p1n	p2t	{4, 5}	{3, 4, 5, 6}	NO
p1n	p2c	{5, 7, 8}	{7, 8}	NO
p1t	p2n	{1, 3, 6, 8}	{0, 1, 2}	NO
p1t	p2t	{3, 6}	{3, 4, 5, 6}	NO
p1t	p2c	{3, 6, 8}	{6, 7, 8}	NO
p1c	p2n	{2, 4}	{0, 1, 2}	NO
p1c	p2t	{4}	{3, 4, 5, 6}	NO
p1c	p2c	{4}	{7, 8}	NO

For more details, see the log file.