Based on:
Michael Wooldridge. *Reasoning about Rational Agents.* MIT Press, Cambridge, Mass. 2000. Chapter 7.

Agent Communications
BDI Logic

CPSC 662/CPSC 568
Rob Kremer
Department of Computer Science
University of Calgary

Basics

- First order model logic with identity
- Three primitive *attitudes*:
  - $B_i p$ — i (implicitly) *believes* p
  - $U_i p$ — i is *uncertain* about p but thinks that p is more likely than ¬p
  - $C_i p$ — (*choice*) i desires that p currently holds
- Other attitudes:
  - $PG_i p$ — i has p as a *persistent goal* (desire?)
  - $I_i p$ — i has the intention to bring about p

Actions

$a_1 ; a_2$	*sequence* in which a_2 follows a_1.
$a_1 \mid a_2$	nondeterministic choice in which either a_1 happens or a_2 happens, but not both.
Feasible(a,p)	a can take place and, if it does, p will be true just after that. (Feasible(a) ≡ Feasible(a, True)
Possible(p)	≡ ∃a.Feasible(a,p).
Done(a,p)	a has just taken place and p was true just before that. (Done(a) ≡ Done(a,True)
Agent(i,a)	i is the only agent that ever performs (in the past, present or future) the actions a.
Single(a)	a is not a sequence. ¬Single(a_1;a_2), but Single(a_1|a_2) iff Single(a_1)∧Single(a_2)

Abbreviations

$Bif_i p$	$\equiv B_i p \vee B_i \neg p$
$Bref_i\ Ix\delta(x)$	$\equiv \exists y.B_i(Ix\delta(x) = y)$. Agent i believes that it knows the (x which is) δ.
$Uif_i p$	$\equiv U_i p \vee U_i \neg p$
$Uref_i\ Ix\delta(x)$	$\equiv \exists y.U_i(Ix\delta(x) = y)$.
$AB_{n,i,j} p$	$\equiv B_i B_j B_i \ldots p$. n is the number of B operators alternating between i and j.

Property: intending to achieve a RE

$\models (\exists x . B_i\, a_k = x)$ // there exists an action
$\wedge\ RE(a_k) = p$ // who's RE is p
$\wedge\ \neg C_i \neg Possible(Done(a_k))$ // that i thinks should be done
$\rightarrow (I_i p \rightarrow I_i Done(a_1 \mid \ldots \mid a_n)$ // then if i intends p, then i intents one of the act that can achieve it

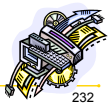
"If I intent to break the vase, then I intent to either drop it, or smash it with a hammer"

Property: satisfiability of intent

$\models I_i Done(a) \rightarrow B_i Feasible(a) \vee I_i B_i Feasible(a)$

If agent i intends a, then it needs to believe a is feasible or at least have the intent to discover if a is feasible

"If I intend to build a perpetual motion machine, then I have to believe it's possible or to at least discover if it's possible."



Property: intent of act implies intent of RE

$\models I_i Done(a) \rightarrow I_i RE(a)$

If agent i intends a, then it also intents the RE of a

"If I intend to drop the vase, then I also intend to break the vase"

Property: observing an act

$\models B_i(Done(a) \wedge Agent(j,a) \rightarrow I_j RE(a))$

If agent i observes j doing a, then i will come to believe the j intends the RE of a.

"If I see Jane hammering the vase, then I believe that Jane intends to break the vase"