Jape: an interactive, user-adaptable calculator for formal proofs

1 :	Q→R	assumption
2 :	P∨Q	assumption
3 :	P	assumption
	…	
4 :	P∨R	
5 :	Q	assumption
6 :	R	→-E 5,1
	…	
7 :	P∨R	
8 :	P∨R	∨-E 2,3-4,5-7
9 :	(P∨Q)→(P∨R)	→-I 2-8

forward and backward reasoning in natural deduction

Computer scientists and software engineers nowadays need to understand formal logic – perhaps to specify programs and to verify specifications, perhaps to understand the roots of their subject. But it's well knownthat formal proof is a difficult skill to learn and to use.

$$\dfrac{\dfrac{\dfrac{\dfrac{}{P \vdash Q,\ P}\,\text{axiom}}{\vdash P \to Q,\ P}\,\vdash\to \qquad \dfrac{}{P \vdash P}\,\text{axiom}}{(P \to Q) \to P \vdash P}\,\to\vdash}{((P \to Q) \to P) \to P}\,\vdash\to$$

Pierce's law in multiple-conclusion sequent calculus

Jape is a proof calculator with a well-designed graphical interface. It is user-adaptable to a wide range of interesting logics – from the obvious predicate logics like natural deduction and the sequent calculus through equational reasoning and polymorphic type-assignment to authentication-protocol verification.

1 :	A⊨(A,S)↔Kas, A⊨(∀k.S⇒(A,B)↔k), A⊨#Na, A◁{Na+(A,B)↔Kab+B⊢Nc}Kas	assumptions
2 :	A⊨S⇒(A,B)↔Kab	P⊨(∀x.X)⇒P⊨X[x\Y] 1.2
	…	
3 :	A⊨S⊨(A,B)↔Kab	
4 :	A⊨(A,B)↔Kab	P⊨Q⇒X, P⊨Q⊨X⇒P⊨X 2,3

BAN protocol-authentication logic

Interaction with Jape is a matter of pointing and clicking. At every stage you see the progress you have made, and you can to choose what to do next and where to do it.

Jape is especially well-suited to education: its interface is simple enough for undergraduates to pick up immediately, and it's easy for you to adapt it to your favourite logic.

	…	
1 :	rev(rev⟦⟧)=⟦⟧	
	…	
2 :	rev(rev⟦x3⟧)=⟦x3⟧	
3 :	rev(rev xs)=xs, rev(rev ys)=ys	assumptions
	…	
4 :	rev(rev(xs++ys))=xs++ys	
5 :	rev(rev x)=x	listinduction 1,2,3-4
6 :	rev(rev x)=id x	Foldid 5
7 :	(rev•rev)x=id x	Fold•6
8 :	rev•rev=id	ext 7

Equational reasoning in functional programming

Jape is *free* and it's on the WWW:
for X users it's at ***http://www.comlab.ox.ac.uk/oucl/users/bernard.sufrin/jape.html***;
for MacOS aficionados at ***ftp://ftp.dcs.qmw.ac.uk/programming/jape/index.html***.
Contact Richard Bornat (richard@dcs.qmw.ac.uk) or Bernard Sufrin (sufrin@comlab.ox.ac.uk) for more information